

# MONTHLY WEATHER REVIEW,

## JANUARY, 1881.

(General Weather Service of the United States.)

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WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

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### INTRODUCTION.

In preparing this REVIEW the following data, received up to February 20th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 136 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 181 monthly journals and 171 monthly means from the former, and 14 monthly means from the latter; reports from 5 Sunset stations; 241 monthly registers from Voluntary Observers; 67 monthly registers from United States Army Post Surgeons; Marine Records: International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Services of Iowa and Missouri and of the Central Pacific Railway Co.; reliable newspaper extracts; special reports.

### BAROMETRIC PRESSURE.

The isobarometric lines in black on chart No. II show the mean pressure for the month of January, 1881. Compared with chart No. II of the preceding REVIEW it will be seen that the area of mean high barometer has advanced east towards the Atlantic coast, at least within the limits of the United States, while the area of mean low barometer remained central in the North Atlantic. This easterly movement has been more in the form of an extension of the high area of last month towards the east, as the centre of greatest pressure remains in the Mississippi valley, where the mean barometer for the month is slightly below that of the preceding month. The most marked change in the mean monthly pressure occurred on the Pacific coast. The area of mean low barometer, central in the North Pacific last month and including Washington Territory and Oregon in the southeastern quadrant with a pressure of 29.88, has been replaced by a mean pressure of 30.08 at Olympia and 30.14 at Portland and a general increase of pressure at all stations on the coast. Compared with the January of last year it will be observed that the distribution of pressure was strikingly different in the two months. The pressure during January, 1880, was greatest on the Atlantic coast, with an area of low pressure near the centre of the continent, and this was accompanied by the highest mean temperature observed for many years at northern stations, while the reverse obtains during the January of 1881, both as regards pressure and temperature.

*Departures From Normal Values for the Month.*—The pressure has generally averaged from 0.02 to 0.08 inch above the normal, except in the Gulf and South Atlantic States, where it has averaged from 0.02 to 0.05 inch below the mean for many years. The greatest departures are observed on the Pacific coast, being at Olympia, 0.16 inch above. At San Francisco and San Diego the pressure ranged from 0.02 to 0.04 inch above.

*Barometric Ranges.*—The barometric range during the month increases with the latitude on the Atlantic coast from 0.45 inch at Key West to 1.42 inch at New York. From New York northward the range decreases to 1.01 at Portland, and 1.04 at Eastport. Following the Mississippi

valley, the range increases from 0.76 at New Orleans to 1.33 at Cairo, and thence northward it decreases to 1.14 at St. Paul, 1.13 at St. Vincent, and 1.05 at Duluth. The range increases with the latitude on the Pacific coast from 0.48 at San Diego, 0.63 at San Francisco, 1.45 at Olympia, and 1.56 at Umatilla. The greatest ranges reported are, 1.58 at North Platte, 1.56 at Fort Buford, 1.45 at Sandusky and 1.49 at Philadelphia. The smallest are, 0.36 at Tucson, 0.45 at Key West, 0.52 at La Mesilla, and 0.60 at Santa Fe.

*Areas of High Barometer.*—Eight of these areas have passed over the districts east of the Rocky Mountains during the month, and two extended periods of high pressure occurred on the Pacific coast; the first extending from the opening of the month until the storm of the 10th, and the other from the 16th until the 24th. High areas Nos. II, III and V. appear to have formed east of the Rocky Mountains, as a part of the permanent areas above referred to, previous to their advance as separate areas of high pressure. The course of these areas over the northern districts has caused a marked increase in the mean pressure for the month in these districts. Generally they were first observed in the extreme Northwest, or in the Saskatchewan region, and thence moved first to the southeast and then to the east, over latitudes north of the mean latitude of the centres of such areas.

No. I.—This area passed from the Northwest during the preceding month, and was central near Washington, D. C., on the morning of the 1st. The centre of greatest pressure continued near the coast during the remainder of the day, it having moved northward to near Albany, N. Y., by midnight. The depression which was central in the East Gulf on that day, moved rapidly to the northeast, and was followed by a general rise of the barometer in the Southern States on the 2nd. At the a. m. report of the 2nd the centre of greatest pressure had moved southwest to eastern Tennessee, and during the day it disappeared to the eastward.

No. II.—The high pressure on the Pacific coast on the 2nd extended eastward over the stations in the extreme Northwest, where this probably developed as a separate area leaving the barometer about 0.40 above the normal on the North Pacific coast. The pressure increased to 30.55 at Yankton on the 3rd, and the temperature ranged from  $+20^{\circ}$  to  $-30^{\circ}$  in the Northwest. During the 3rd this area moved to the central valleys, and separated the storms traced on Chart No. I, as Nos. II and III, the former being central near New Orleans and the latter near St. Vincent, Minn., on the morning of the 4th. The depression from the south and the cold northerly winds from this area of high pressure resulted in quite a severe "norther" in Texas, which continued during the 4th, with light snow, as far south as Indianola and temperature generally below  $20^{\circ}$  at interior stations. This area disappeared in the central Mississippi valley as storms Nos. II and III, developed within the limits of the stations.

No. III.—The very low temperature reported in the Northwest Territory and a general rise of barometer in the region between the Mississippi valley and the Rocky Mountains on the 5th, indicated the approach of this area. On the night of the 5th, the temperature fell to  $-45^{\circ}$  at Edmonton, in the Saskatchewan valley, and snow, with cold northerly winds, prevailed on the eastern Rocky Mountain slope, from the northern boundary of the United States southward to Texas. During the 6th, the pressure continued to increase in the Western districts, and colder, clearing weather prevailed in the Northwest, the Southwest and the Mississippi valley, as the centre of greatest pressure moved southward to the central Missouri valley. On the morning of the 7th, the centre had advanced to the Lower Missouri valley and light snows were reported from the Lake region, where the barometer was rising, with a decided fall of temperature in the western portion of this region. Although the pressure had declined in the Upper Missouri valley and Manitoba, the centre of greatest cold remained in the region west of Lake Superior, the minimum temperature on the morning of the 7th, being  $-33^{\circ}$  at Ft. Buford,  $-32^{\circ}$  at St. Vincent,  $-31^{\circ}$  at Ft. Garry and  $-29^{\circ}$  at Prince Arthur's Landing on the north shore of Lake Superior. The pressure increased in the Lake region and in the districts on the Atlantic coast on the 7th, with colder, clearing weather as the area passed to the east, north of the Ohio valley. The a. m. reports of the 8th, showed a rapid increase of pressure in the Middle and New England States, and that this area had apparently divided into at least two areas, one central near Burlington, Vt., and the other central near Breckenridge in the Northwest. At this report, the pressure ranged from 30.40 to 30.60 from the St. Lawrence valley westward to the Pacific coast. The midnight report of this date exhibited three areas of high barometer, one central in New England, one in the Lower Missouri valley, the pressure being 30.75 at Yankton, and one central on the North Pacific coast, where the pressure was 0.40 above the normal for the month. The first area central in New England on the 9th, passed to the northeast over the Maritime Provinces and disappeared to the east, followed by north to east winds and heavy snow in the northeastern portions of the United States on the 10th. The second area, central in the Northwest on the 9th, moved slowly to the southeast, with decreasing pressure at the centre and, during the 11th, extended over the Southern States, attended by clear, cold weather. The temperature being generally below freezing in the western portion of the South Atlantic States on the night of the 11th. The winds shifted to east and south on the South Atlantic coast on the 12th, as the area passed east of the coast stations.

No. IV—followed the storm traced as No. VII on chart No. I and moved rapidly from British Columbia to the Eastern Rocky Mountain slope during the 13th. Unusually cold weather prevailed in Manitoba and Dakota on the morning of the 13th, when Forts Garry and Buford reported minima of  $-40^{\circ}$ . The centre passed to the south of Nebraska during the night of the 14th, causing a severe "norther" on the Texas coast, the wind reaching a velocity of 48 miles from the Southwest and 44 miles from the north at Indianola, when a Cautionary Off-shore Signal was displayed. Had the high southerly winds been anticipated the usual Cautionary Signals would have been ordered in this case. Not only was warning given to the coast stations of the approach of this and other severe storms, but the citizens throughout Texas located on the military telegraph line under the supervision of an officer of this Service received special warnings of the approach, of "northers," and these warnings have proved valuable during the month, especially to the stock interests of the State. Heavy frosts were reported in the Southwest and temperature fell to  $29^{\circ}$  at Indianola on the 14th. The centre of this area moved east to the Central Mississippi valley, where its course changed to the northeast, and during the succeeding 24 hours it passed to the northeast over the St. Lawrence valley attended by freezing weather on the Atlantic coast as far south as Atlanta, Ga., and Wilmington, N. C.

No. V.—This area apparently developed south of the Upper Missouri valley and east of the Rocky Mountains on the 15th and 16th, while heavy rains prevailed on the Pacific coast. It advanced slowly over the Northwest, and by midnight on the 16th was central near Yankton, where the barometer read 30.57 and the temperature was  $-15^{\circ}$ . Light snow and cold northerly winds preceded this area as it advanced over the Lake region on the 17th, with increasing pressure at the centre. On the morning of the 18th the isobar of 30.70 included the Middle States, Lower Lake region and a portion of New England, and near the centre of the greatest pressure the temperature was below zero. The pressure continued high on the Atlantic coast during the 19th as the area disappeared to the northeast. During the transit of this area over the northern districts of the United States the barometric changes, although decided, occurred gradually, attended by generally fair weather.

No. VI.—The pressure increased rapidly in the region west of the Mississippi after the severe storm of the 20th and 21st. The reports of the 22nd showed an area of high pressure extending from Manitoba to the Pacific coast, within which the pressure ranged from four to six tenths above the normal for the month. The barometer rose gradually over the districts east of the Mississippi on the 24th and 25th, the centre of greatest pressure passing to the lower Mississippi valley with freezing weather throughout the Southern States. The pressure continued to increase in the Southern districts on the 25th and during the 26th the area was included within the limits of No. VII, which was more marked and central in the Northwest.

No. VII.—This was the most marked area of high pressure of the month; at midnight of the 25th it was central in Wyoming Territory and during the 26th the pressure ranged from 0.20 to 0.50 above the normal over the eastern slope of the Rocky Mountains. A light "norther," without rain, occurred in Texas, but the temperature did not fall decidedly in the Southwest. On the morning of the 28th, the isobar of 30.50 inclosed the Southern States and the Lake region, while the central pressure of 30.70 extended over the Ohio valley and Tennessee. The pressure decreased gradually during the 29th, as this area disappeared to the east immediately in advance of the storm traced as No. VIII on the storm-chart.

No. VIII.—extended over British America north of the Lake region on the 31st, attended by very cold weather from the St. Lawrence valley westward to the Saskatchewan region, where the temperature was  $-30^{\circ}$  at the 11 p. m. report of the 30th. This was probably the most extended area of high pressure of the month, but as its centre passed to the Atlantic northeast of the United States only the northeastern districts experienced the severe cold accompanying it.

*Areas of Low Barometer.*—Nine areas of low barometer appeared within the limits of the stations of the Signal Service, during the month, three of which (Nos. I, III and V) originated south of the 30th parallel of latitude. Three probably originated in the north Pacific and three (Nos. II, IV and IX) were first observed on the eastern slope of the Rocky Mountains. No. IX was preceded by violent storms and heavy rains on the Pacific coast, and reports from mountain stations indicate that a slight depression crossed the Rocky Mountains south of Salt Lake on the 30th.

No. I.—This storm was central in the Eastern Gulf near Punta Rasa on the morning of the 1st, where it apparently developed during the preceding night. The centre of disturbance, although slight, remained near the west coast of Florida until the p. m. report of the 1st and by midnight it had passed to the South Atlantic in a northeast direction attended by severe northeasterly gales on the North Carolina coast. The temperature was below freezing generally at stations in the Gulf and South Atlantic States on the 1st and light snow occurred at Pensacola, Fla. and Mobile, Ala., and very heavy rains prevailed in Florida before the centre of disturbance passed to the Atlantic. Cautionary Signals were displayed at stations on the coast from Pensacola to Sandy Hook, and were generally verified at stations north of Wilmington. The high wind at Hatteras and the general course of the storm indicate that dangerous winds prevailed off the South Atlantic coast



during the display of signals at stations south of Hatteras. This storm passed rapidly to the east of the coast on the night of the 1st with apparent increase of force.

No. II.—This depression probably developed west of the Rocky Mountains, near the northern boundary of the United States, on the last day of the preceding month. On the 1st of January the centre of lowest pressure, although slight, moved rapidly to the east over the parallel of  $45^{\circ}$ , attended by snow and followed by cold northerly winds in the district west of the Mississippi. The course of the depression changed from east to northeast on the 2nd as it moved rapidly east of the Upper Lake region, causing but a slight disturbance in the northern districts. Light snows were reported in the Lake region, the New England and Middle States and St. Lawrence valley. As this area passed toward the Atlantic, and after the wind shifted to the northwest, the temperature fell to  $-20^{\circ}$  at interior stations in Canada. The winds increased in force as the depression approached the coast, and marine reports show dangerous westerly winds, with hail and snow, off the coast of Newfoundland on the 2nd.

No. III.—This storm developed in the West Gulf during the 2nd, but its centre could not be located on the tri-daily charts until the a. m. reports of the 3rd, when it was south of Galveston. The heavy rain on the west Gulf coast, extending as far east as New Orleans, indicated the northeasterly movement of this storm. Between the p. m. and midnight reports, 1.58 inches of rain fell at Pensacola, 1.33 at Mobile, and 1.67 at New Orleans. The centre moved slowly to the northeast during the 3rd and 4th, passing over New Orleans, where the wind reached a velocity of 34 miles, from the east, while the maximum velocity at Indianola was 36 miles, from the north. The rain extended over the Southern States during the 4th, and snow prevailed in the Ohio valley, Lake region, Middle States and New England, as the centre advanced to the northeast. Northeasterly gales continued on the North Carolina coast during the 5th, but the wind did not reach the high velocities anticipated, owing to the northerly course of the storm after the centre had reached eastern Tennessee. During the night of the 5th, rain or snow fell in all districts east of the Mississippi, the centre of disturbance being near Pittsburg, where the pressure was 29.59. The barometer continued to fall at the centre of the storm, and it passed over the Lower Lake region with increasing violence. On the 6th the wind increased to gales as it passed over the Maritime Provinces. The p. m. report of the 6th indicated that a secondary depression had formed on the New England coast as this depression passed down the St. Lawrence valley, and the marine reports from the *City of Berlin* show ESE. gales in latitude  $41^{\circ}$  N. and longitude  $66^{\circ}$  W. on that day. The Cautionary and Off-shore Signals displayed in advance of this storm were verified, except at stations south of Wilmington and east of New Orleans, and at these stations the velocity ranged from 18 to 24 miles per hour.

No. IV.—This storm was central in Manitoba on the morning of the 4th, while the preceding depression was central near New Orleans. These two depressions, central within the limits of the United States on the same day, moved in opposite directions, as shown by the chart. The p. m. report of the 4th showed a well defined depression of 29.50 central in northern Minnesota, with snow and rain extending over Dakota, Nebraska and Montana. The snow extended southward as the central area moved south during the 5th, and by midnight the storm had reached northern Texas, and snow or rain prevailed in all districts, except in the Southwest. This depression disappeared after the midnight report of the 5th, and was followed by a general rise of barometer in the western districts, and a light "norther" in Texas on the 6th, during which the temperature was generally below freezing at stations in the Southwest.

No. V.—The gradual fall of the barometer over the region of the Gulf, and the heavy rains in Florida on the 8th, indicated the development of a low area in that region. High winds were reported from Key West and Cedar Keys on the night of the 7th, resulting from a slight depression, which disappeared during the day, leaving the barometer low over the Gulf, with conditions indicating the speedy development of a severe storm. The centre of disturbance appeared to be in the West Gulf, to the south of Galveston, during the 8th, the wind reaching a velocity of 42 miles from the north at Indianola, and 28 miles from the northeast at Galveston. Heavy rain occurred at stations on the Gulf coast during the day, and by midnight rain or snow was reported from all districts east of the Mississippi. The barometer fell rapidly during the night, and the advance of the high area from the northwest was accompanied by a rapid transfer of the centre of disturbance from near Mobile, Ala., to the Middle Atlantic coast during the eight hours following the midnight report of the 9th. The pressure continued low in the South Atlantic States, with variable winds on the morning of the 10th, but during the day the winds shifted to the north and west, with a decided fall in temperature and increased pressure, and by the morning of the 11th. The centre moved to the northeast over the New England coast, causing violent northeasterly gales and very heavy rains at stations located near the track of the centre of greatest depression. The region of snow extended from Texas northeast to New England, where trains were delayed several hours during the 10th and 11th. Many observers located in the northeastern section of the country reported this as the severest storm of the season. At Bellow's Falls, Vt., nearly three feet of snow reported. The observer at Portsmouth, N. H., reports storm outside of harbor par-



ticularly severe—large fleet of vessels in harbor. Toronto observer reports heavy snow storm throughout Ontario. The British brig *Happy Return* went ashore near Nantucket Beacon—total loss. A violent southeast storm occurred at Provincetown, Mass., causing some damage to shipping on the 10th. Voluntary observers throughout New England report from 12 to 18 inches of snow. Cautionary Signals were displayed in advance of this storm, but they were not generally justified at the stations on the East Gulf and South Atlantic coasts. The Off-Shore signals on the West Gulf coast and the Cautionary Signals north of Cape Hatteras were generally justified, although in some cases the Signal was late.

No. VI.—This depression passed from the Pacific coast to the Atlantic, on or near the parallel of  $45^{\circ}$ , during the five days commencing on the afternoon of the 10th. At the midnight report of the 10th the barometer had fallen over three-tenths of an inch during the preceding eight hours, in Washington Territory, with 1.40 inches of rain at Olympia and 1.32 inches at Portland in eight hours. The belt of rain gradually extended south over northern and central California and the centre of this depression passed to the east of the coast-line at midnight of the 10th, when the barometer read 0.50 below the normal at Olympia near the centre. As the storm passed to the mountains heavy snows occurred, both on the east and west slope, at all stations on the Northern Division of Military Telegraph Lines, extending from Bismark to Fort Cœur d'Alene. The *Oregonian* of the 15th reports the Santiam river highest for eight years, bridges washed away, trees uprooted and carried into the channel. Several lives lost by heavy land-slides and buildings crushed by snow from the mountains. Unusual snows reported in the Silver City Mountains, Idaho, on the 11th, blockading all roads. At The Dalles an immense quantity of logs, railroad ties and wrecked bridges floating down the Columbia. At Harrisburg the water rose to within six inches of the high water of 1861, the town being flooded and a large number of stock drowned. After passing the mountains the general course of the storm was to the south of east until it had passed the centre of the continent and then the course changed to the northeast, except a slight curve while the centre was over the Upper Lakes. On the morning of the 12th the storm extended over all the districts east of the Rocky Mountains, the barometer at the centre reading 0.60 below the normal for the month over the State of Missouri, and 0.30 below the normal at stations in the Lake region and thence southwestward to Texas. During the 13th the temperature ranged from  $39^{\circ}$  to  $73^{\circ}$  above zero in the southern and eastern quadrants of the depression as it passed over the Lake region, while in the western quadrants it ranged from  $+33^{\circ}$  to  $-20^{\circ}$ . The most marked difference being in Texas, where the temperature at Fort Stockton was  $73^{\circ}$ , while at the same report it was  $12^{\circ}$  at Fort Elliott. This depression became elongated from the SW. to NE. as it approached the coast closely followed by an area of high barometer. At the centre the pressure increased as the storm passed to the east of New England. Cautionary Signals were displayed in advance of this storm on the Atlantic coast north of Wilmington and at Milwaukee and Grand Haven, and Cautionary Off-shore Signals on the Texas coast in advance of the "norther" which immediately followed. The maximum winds reported are as follows: Eastport, 40 miles per hour NW.; Boston, 42 NW.; Shoreham, 38 NW.; Atlantic City, 48 NW.; Del. Breakwater, 52 W.; Kittyhawk, 56 NE.; Hatteras, 48 N.; Indianola, 48 SW. and 44 N. Warnings were also forwarded to the Canadian Meteorological Service for stations in the Maritime Provinces.

No. VII.—The tri-daily reports of the 12th and 13th indicated the advance of a second area of low barometer from the Pacific coast, and the succeeding reports of that day show that the centre of this depression passed east of the coast from the north Pacific about midnight of the 12th. Heavy rains continued during the 13th and 14th in Washington Territory, Oregon and northern California and snow in Idaho, Montana, Dakota, and Wyoming. As the centre of lowest pressure passed to the southeast from British Columbia to the Lower Missouri valley during the 14th, the barometer fell on the south Pacific coast and thence eastward to the Mississippi valley, and the rain extended south to San Diego. The pressure continued low in the Southwest during the 15th, 16th and 17th as the depression passed slowly to the south from Omaha, accompanied by no marked disturbance until the approach of an area of high barometer from the northwest. A sudden fall of temperature and rapid increase of pressure were followed by a "norther" in Texas at Indianola and Galveston on the night of the 17th, and from this date the course of the low area changed to the northeast. On the 18th and 19th the centre advanced slowly from the West Gulf coast towards New Orleans, accompanied by heavy rains, over 4 inches of rain falling at New Orleans during the night of the 18th. The rain-area extended rapidly and included the Southern States, Ohio valley and southern portion of the Middle States by the a. m. report of the 20th, when the centre of this storm was near Memphis, Tenn. The barometer continued to fall at the centre of the storm and the gradient increased with the progressive movement to the north over the Ohio valley. At midnight of the 26th, the centre was inclosed by an isobar of 29.40, the centre of disturbance being to the west of Cincinnati. At this report, the three stations nearest the centre of the storm reported, as follows: Indianapolis, 29.40, temperature  $33^{\circ}$ , wind 12 N., rainfall 0.63 inch; Louisville, 29.39, temperature  $40^{\circ}$ , wind 12 SW., rain-fall 1.18; Cincinnati, 29.38 temperature  $41^{\circ}$ , wind 4 NE., rain-fall 0.70. At this point the course changed and the a. m. report of the 21st showed a rapid advance

to the east attended by violent NE. and ESE. gales on the Middle and South Atlantic coasts. The gradient increased rapidly in the northeast quadrant on the 21st, as the lowest pressure passed over the Middle States and along the New England coast, causing heavy snow from the Northeast coast westward over the Lake region, and rain changing to snow and sleet from southern New England southwestward to Texas. Cautionary Signals were displayed in advance of this storm at the stations on the Atlantic coast and succeeding reports show it to have been the most severe storm of the month. The wind reached a velocity of 40 miles per hour at New York City and much damage to property was reported in that vicinity, especially to the telegraph lines which were damaged to such an extent as to interrupt communications with other cities. The tri-daily telegraphic reports of this office were missing from the northern districts, and for several days were sent from New York by rail to the first telegraph station south in communication with Washington. The Boston observer reports a velocity of 44 miles NE., wind violent from 1:30 p. m. to following morning and a sudden gust of 60 miles—communication of all kinds obstructed, the greatest damage occurring to telegraph lines, snow-fall from 12 to 14 inches, losses estimated at \$100,000. New York City reports this as the most violent storm of the season. At Ashbury, N. J., the "Mammoth Hotel" in course of construction, demolished by gale which reached a velocity of 80 miles during the afternoon. Many losses occurred on the New Jersey coast. The maximum velocity at Eastport was 40 miles NE.; at Portland, 35 NE.; Wood's Holl, 42 E.; Sandy Hook, 45 NE.; Del. Breakwater, 52 N.; Kittyhawk, 49 SW.; Hatteras, 40 SW. The centre of lowest pressure passed to the east south of Halifax, after leaving the New England coast.

No. VIII.—This depression passed east from the Pacific over Washington Territory on the 28th, causing heavy rains and damaging floods in that region. The rains extended over California on the night of the 28th and continued during the remainder of the month as the severest storm in that region for many years. The unusual rain-fall and damage resulting from floods caused by this storm are noticed under the proper heading. The rains continued on the Pacific coast after the centre of depression had passed to the east of the Rocky Mountains, near the northern boundary of Idaho. The area passed over the Missouri valley and the Lake region during the 29th and 30th with the high average velocity of 47 miles per hour, but the pressure at the centre increased as it approached the Atlantic, and it disappeared as a cyclonic disturbance before reaching the New England coast.

No. IX.—This storm is marked on the chart as first central in northern Texas at midnight of the 30th, but it is probable that it passed from the Pacific coast or that its development was due to the heavy rain in that region on the previous day. The course of the centre after its first appearance was to the northeast until the centre reached the Ohio valley as a well defined storm, accompanied by very heavy rain near the central area, which, at that time, was marked by a small elliptical isobar of 29.80, central near Louisville at the 11 p. m. report of the 31st. The succeeding reports show that the direction of the area changed slightly on the following day, and that it passed off the South Atlantic coast, causing dangerous winds as far north as Boston. Cautionary Signals were ordered in advance of this storm at stations north of Ft. Macon, N. C. The maximum velocities reported were as follows: Macon, 32 N.; Hatteras, 40 N.; Kittyhawk, 52 N.; Cape Henry, 43 NW.; Del. Breakwater, 45 NW.; Cape May, 56 NW.; Wood's Holl, 28 NW.; Shoreham, 36 NE.; Barnegat, 48 W.

## INTERNATIONAL METEOROLOGY.

Three International charts accompany the present REVIEW. No. IV is for the month of *December*, 1880. In lieu of charts Nos. V and VI for the month of *May*, 1879, which would have appeared with this issue if the regular order of publication had been adhered to, charts No. V for the months of *January* and *February*, 1877, are presented. The delay in the publication of the *May*, 1879, number of the "Monatliche Uebersicht der Witterung" of the "Deutsche Seewarte," is the reason for this change, that publication containing much valuable data which, previous to the month of April, 1879, was made use of in computing the mean pressure and wind-direction over the Atlantic ocean. It is therefore deemed advisable (while waiting for the above) to endeavor to complete, as well as possible, the series of charts No. V for the year 1877, by the publication of those for the eight months from January to August, inclusive. In these charts, the barometric pressure over India from January to May, inclusive, will be indicated by isobars, in broken lines, copied from the "Report on the Meteorology of India in 1877," published by the government of that country, the simultaneous observations not commencing until June, 1877.

*Chart No. IV*, for the month of *December*, 1880, indicates as well as is at present (*February* 16th, 1881) possible the general course taken by the most prominent storms over North Atlantic during that month. Nos. I, III, IV and V are continuations of low areas Nos. 11, VII, XI and XV, respectively, of chart No. I for December. No. II appears to have developed during the 10th and on the morning of the 11th was central between the Bermudas and Newfoundland. These and other storms of less importance will be noticed in detail on the appearance of chart No. VI for this month. The weather over the Atlantic during this period may be characterized as very

stormy, except during the regime of an area of high barometer over the eastern portion, which set in on the 7th and continued to the 14th, the maximum pressures of the month (about 30.70 or 779.8) occurring on the 9th to the southwest of the Irish coast. The storms having their tracks charted were generally accompanied by pressures below 29.40, or 746.8, the lowest minimum barometric reading yet reported being 28.60, or 726.5, experienced by *S. S. Republic* at 4 p. m. of the 10th in about 50° N., 35° W., in connection with the storm the track of which is given as No. I.

*Charts No. V.*—These charts, of which two are published this month, show the mean pressure, temperature and wind force and the prevailing direction of the wind at 7.35 a. m. Washington, or 0.43 p. m. Greenwich, meantime, for the months of *January* and *February*, 1877, over the northern and at certain isolated stations in the southern Hemisphere. The chart for *January* shows an immense area of low pressure (below 29.90 or 759.4) probably covering the whole of the North Polar region and apparently extending southwards over the Atlantic Ocean to the 45th parallel. The mean pressures at the most exposed northern stations are: St. Michaels and York Factory, 29.89; Godthaab, 29.20; Stykkisholm, 29.17; Thorshavn, 29.44, and Thromso, 29.58, the lowest barometric mean being found over Iceland. The region of highest mean pressures is found to cover quite generally the zone included between the 30th and 40th parallels over the United States, Spain and Algeria, but extending northwards over eastern Europe and Asia to the 60th. The maximum mean is that of Pekin (30.45 or 773.4), giving a barometric range in the mean monthly pressure of 1.28 inches; Barnaul is 30.44 and Shanghai 30.43. The highest and lowest barometer readings, reduced to sea-level, reported by co-operating observers during the month, were, respectively: Barnaul, 31.21 or 792.7 on the 9th, and Stykkisholm, 28.03 or 712.0 on the 13th, showing a total barometric range of 3.18 inches. In the distribution of temperature the region of greatest continued cold appears to have been over Hudson's Bay Territory, York Factory having a monthly mean of -23°, while Yeniseisk, the next in order, was only -11°. Extremely low temperatures were reported, as follows: St. Michael's, Alaska, -32.5°; York Factory, -42° and Nertschinsk -44°. Over the middle latitudes the predominating winds appear to have been *southerly*, except along the northern shores of the Gulf of Mexico and the Mediterranean where a decided northerly direction prevailed. The chart for February shows the same general features, the lowest barometric mean, 29.46 or 748.3 being at Stykkisholm and the highest 30.40 or 772.2 at Barnaul, giving a barometric range in the monthly mean pressures of 0.94 inch. The highest and lowest barometric readings were 30.85 or 783.7 at Barnaul on the 21st and 27.91 or 708.8 at Stykkisholm on the 1st, giving a total barometric range of 2.94 inches. The region of greatest continued cold is found over Behring's Sea; St. Michael's -26.5°. At this station the extremely low temperature of -50° was observed on the 19th. The predominating winds were *northerly* in America, Algeria and along the eastern coast of Asia, and *southerly* over Europe and western Asia. In comparing these two months, the most marked changes are found to be a large increase of pressure during February over the northern portions of America and the Atlantic, with an increase in temperature at York Factory of 18° and at Stykkisholm of 11°, and a decrease at St. Michael's of 27°. The greatest change in barometric pressure, however, is found over Russia, where a decrease of more than 0.40 in. occurred at Dorpat, Moscow, Kieff and Orenburg. The changes in temperature over Europe were small compared with those given above, but in Asia an increase of 10° occurred at Nukuss and 11° at Yeniseisk.

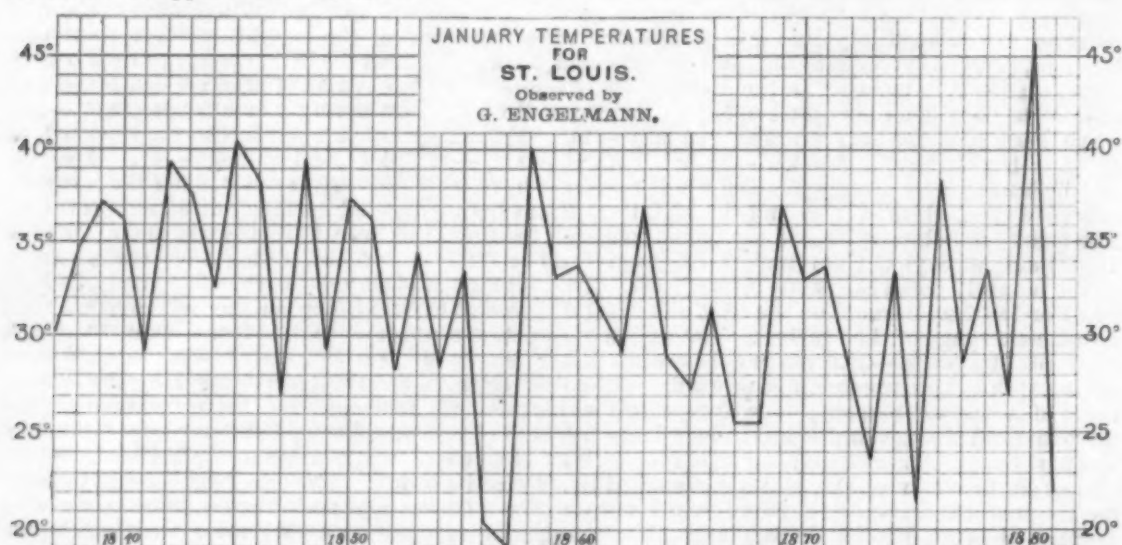
## TEMPERATURE OF THE AIR.

The mean temperature of the air for January, 1881, is shown by the isothermal lines for the month on chart No. II. The table in the right-hand corner of this chart gives the average temperature for January in the several districts, determined from the Signal Service observations; the mean temperature for January, 1881, and the amount of departures from the mean in the last column. It will be seen from this table that the average temperature of the month has been below the normal in all districts east of the Rocky Mountains, and also in the southern districts on the Pacific coast, where it has averaged from 1°.3 to 2°.5 below. The greatest departures occurred in Texas, and northward to British America, and northeastward over the Lake region, where the temperature has ranged from 6°.5 to 9°.0 below the normal of the month. On the Pacific coast the temperature has averaged 3°.5 above the normal in the central districts, about normal in the northern district and 3°.5 above in the region of Salt Lake. The departure from the normal temperature has been greater than during the preceding month, which was the coldest, as compared with records of previous years since the establishment of the Signal Service. This month has been the coldest ever observed in the northern and eastern districts, excepting that of January, 1875; while in the Southern States, east of the Mississippi, the only years showing a lower temperature, were those of 1872 and 1873. At Washington, D. C., the average temperature was lower than that of any preceding January of which this office has any reliable record.

*Deviations from Normal Temperatures.*—Under this head, the departures, as indicated by reports from regular Signal Service stations are shown in the table of average temperatures on the right-hand side of chart No. II. The following interesting items from voluntary observers are of much importance in connection herewith: *California:* Oakland, mean temperature of month 3°.0



above the mean of January for past five years. *Canada*: Montreal, mean  $3^{\circ}.5$  below that of past 6 years and lower than any January except 1875. *Connecticut*: Mystic, month remarkably cold. *Florida*: Houston, month very cold and gloomy, cotton much injured. *Illinois*: Belvidere, mean  $8^{\circ}.45$  below that of past 14 years, and lower than the mean of any January in that period except 1875. Riley, mean  $8^{\circ}.20$  below that of past 18 years and lower than the mean of any January in that period except 1875. Elmira, mean below that of past 19 years. *Iowa*: Clinton, mean below that of several years past. *Kansas*: Lawrence, mean  $5^{\circ}.94$  below that of past 13 years. Holton, coldest in past 14 years. Yates Center, coldest within the memory of the oldest settler. Manhattan, month unusually cold. Clay Center, coldest in past 12 years. *Maine*: Gardiner, mean  $12^{\circ}.16$  or  $5^{\circ}.76$  below that of past 45 years, only four Januaries during that period giving a lower mean, viz: 1844,  $7^{\circ}.08$ ; 1861,  $12^{\circ}.15$ ; 1875,  $10^{\circ}.36$  and 1877,  $11^{\circ}.43$ . *Maryland*: Fallston, mean  $5^{\circ}.20$  below that of past 11 years. *Massachusetts*: Westborough, mean  $13^{\circ}$  below that of January, 1880, and  $5^{\circ}.7$  below that of past 6 years. *Michigan*: Thornville, coldest for many years. *Missouri*: The Missouri Weather Service reports the mean of the month as nearly  $10^{\circ}$  below that of the past 44 years; coldest year occurring in 1857. The following is the curve of mean temperature for January, as furnished by Prof. Niphen, of the "Missouri Weather Service." As compared with the observations taken at the Signal Service station in St. Louis, during the past ten years, these observations appear to be reliable:



*Nebraska*: Howard mean  $6^{\circ}$  below that of past 5 years. *New Hampshire*: Auburn, coldest for several years. Grafton, mean  $6^{\circ}.7$  below that of past 4 years. Contoocookville, mean  $4^{\circ}.25$  below that of past 10 years; coldest occurred in 1875. *New Jersey*: Newark, mean  $24^{\circ}.4$  or  $4^{\circ}.65$  below that of past 37 years and colder than any January during that period except, as follows: 1856,  $21^{\circ}.55$ ; 1857,  $19^{\circ}.33$ ; 1865,  $23^{\circ}.15$ ; 1867,  $22^{\circ}.67$  and 1875,  $22^{\circ}.92$ . *New York*: Palermo, coldest in past 28 years. North Volney, mean  $8^{\circ}.28$  below that of past 12 years; coldest in 1885. Waterburg, mean  $5^{\circ}.07$  below that of past 10 years. Greece, coldest in 40 years. *Texas*: Melissa, coldest ever experienced. *Virginia*: Wytheville, mean  $5^{\circ}$  below that of past 6 years. *Washington Territory*: Neah Bay, mean  $3^{\circ}$  above that of 1880. Bainbridge Island, mean  $1^{\circ}.2$  above that of 1880. *Wisconsin*: Embarrass, coldest ever experienced. Madison, mean  $5^{\circ}.4$  below that of past 13 years.

**Minimum Temperatures.**—The following collection of data relative to the lowest temperatures of the month has been obtained principally from the reports of Voluntary Observers: Elmira, Ill.,  $-32^{\circ}$ , lowest temperature in past 19 years. Vail, Ia., 9th, extremely low temperatures throughout the day ranging from  $-10^{\circ}$  to  $-40^{\circ}$  as follows: 7:45 a. m.,  $-40^{\circ}$ ; 8:30 a. m.,  $-36^{\circ}$ ; 9 a. m.,  $-26^{\circ}$ ; 10 a. m.,  $-20^{\circ}$ ; 11 a. m.,  $-18^{\circ}$ ; 12 m.,  $-15^{\circ}$ ; 1 p. m.,  $-12^{\circ}$ ; 2 p. m.,  $-11^{\circ}$ ; 3 p. m.,  $-10^{\circ}$ ; 4 p. m.,  $-10^{\circ}$ ; 5 p. m.,  $-12^{\circ}$ ; 6 p. m.,  $-16^{\circ}$ ; 7 p. m.,  $-17^{\circ}$ ; 9 p. m.,  $-15^{\circ}$ ; 10 p. m.,  $-17^{\circ}$ . Logan, Ia.,  $-28^{\circ}$ , lowest in past 28 years. Nora Springs, Ia.,  $-24^{\circ}$ , lowest in many years, in vicinity another thermometer records  $-36^{\circ}$ . Manhattan, Kan.,  $-18^{\circ}$ , lowest since 1859. Clay Center, Kan.,  $-31^{\circ}$ , remarkably low. Sandy Springs, Md., 1st, marks the close of the coldest period of three days ever recorded at this station; minimum temperature at station  $-10^{\circ}$ ; in a low valley half-a-mile distant  $-24^{\circ}$ . Billerica, Mass., extremely low temperature at station,  $-24^{\circ}$ , other points in town,  $-22^{\circ}$ ,  $-26^{\circ}$  and  $-28^{\circ}$ . St. Louis, Missouri, Weather Service reports a minimum temperature of  $-9^{\circ}$  at the central station for January, 1881, as compared with  $-23^{\circ}$  reported by Engelmann in 1873. Contoocookville, N. H., at station,  $-20^{\circ}$ , in other parts of village having a lower altitude  $-30^{\circ}$ . North Volney, N. Y.,  $-15^{\circ}$ , lowest in past 12 years, except 1871,

when it was  $-19^{\circ}$ . Wytheville, Va.,  $7^{\circ}$ , lowest in past 6 years. Embarrass, Wis.,  $-38^{\circ}$ , lowest in many years. Stevens Point, Wis., 10th,  $-52^{\circ}$ , lowest ever recorded. Ft. Benton, Mont., 29th,  $-59^{\circ}$ , mean temperature of day  $-54^{\circ}$ , coldest weather ever experienced. Dubuque, Ia., 10th,  $-25^{\circ}$ , lowest since 1875; sparrows by the hundreds were found frozen to death. Cape Lookout, N. C., 1st, coldest in past 20 years as stated by the oldest inhabitants. Jacksonville, Fla., 5th, coldest since 1837, except 1857; all oranges on trees frozen; minimum temperatures at Green Cove, Fruit Cove, Mandarin and Beaulere,  $20^{\circ}$ , Hibernia,  $18^{\circ}$ , Palatka,  $23^{\circ}$ ; oranges badly frozen at all places; Picolata,  $24^{\circ}$ , fruit not injured; Panasofkee Lake, Sumter Co., no damage except to tender buds on young trees. Watertown, N. Y., 15th,  $-14^{\circ}$ , lowest for several years. Greece, N. Y., 31st, extremely cold, snow has remained upon the ground for a longer period than ever before experienced; a cellar wall laid on the 16th of November, 1880, froze solid that night and has remained so up to date. Poughkeepsie, N. Y., 1st,  $-12^{\circ}$  to  $-15^{\circ}$ ; reports from Pleasant Valley, Pine Plains and Millerton show a minimum of  $-25^{\circ}$  to  $-30^{\circ}$ ; along river,  $-15^{\circ}$  to  $-20^{\circ}$ . Petersburg, Va., 1st,  $-4^{\circ}$ , coldest in past 25 years; birds frozen to death in the fields. Fredericksburg, Va., 1st,  $-22^{\circ}$ ; much suffering among the people; cattle and game frozen to death. New Brunswick, 1st, in interior of province exceedingly cold; at Woodstock  $-22^{\circ}$ ; Sussex,  $-20^{\circ}$  and at Rothesay  $-10^{\circ}$ .

The following are the maximum and minimum temperatures reported in each State and Territory:

*Maximum Temperatures.*—Alabama:  $72^{\circ}$  at Mobile. Arizona:  $84^{\circ}$  at Tucson. Arkansas:  $68^{\circ}$  at \*Mount Ida and  $64^{\circ}$  at Little Rock. California:  $76^{\circ}$  at \*Fresno, \*Delano and \*San Fernando and  $71^{\circ}$  at Los Angeles. Colorado:  $65^{\circ}$  at \*Trinidad and  $63^{\circ}$  at Denver. Connecticut:  $46^{\circ}$  at New London. Dakota:  $54^{\circ}$  at \*Fort Meade and  $47^{\circ}$  at Deadwood. Delaware:  $50^{\circ}$  at Delaware Breakwater. District of Columbia:  $44^{\circ}$  at Washington. Florida:  $84^{\circ}$  at Key West. Georgia:  $73^{\circ}$  at \*Thomasville and  $70^{\circ}$  at Savannah. Iowa:  $48^{\circ}$  at \*Glenwood and  $46^{\circ}$  at Keokuk. Idaho:  $52^{\circ}$  at Boise City. Illinois:  $55^{\circ}$  at Cairo. Indiana:  $54^{\circ}$  at \*Laconia and  $47^{\circ}$  at Indianapolis. Indian Territory:  $64^{\circ}$  at Fort Sill. Kansas:  $56^{\circ}$  at Dodge City. Kentucky:  $63^{\circ}$  at \*Bowling Green and  $54^{\circ}$  at Louisville. Louisiana:  $75^{\circ}$  at New Orleans. Maine:  $42^{\circ}$  at Eastport. Maryland:  $46^{\circ}$  at \*Cumberland and \*Woodstock and  $45^{\circ}$  at Baltimore. Massachusetts:  $48^{\circ}$  at Boston. Michigan:  $43^{\circ}$  at Port Huron. Minnesota:  $35^{\circ}$  at St. Vincent and St. Paul. Mississippi:  $71^{\circ}$  at Vicksburg. Missouri:  $54^{\circ}$  at \*Pierce City and  $48^{\circ}$  at St. Louis. Montana:  $47^{\circ}$  at Fort Custer. Nebraska:  $64^{\circ}$  at \*Fort Sheridan and  $45^{\circ}$  at North Platte. Nevada:  $54^{\circ}$  at Winnemucca. New Hampshire:  $39^{\circ}$  at \*Auburn and  $25^{\circ}$  on summit of Mount Washington. New Jersey:  $50^{\circ}$  at Atlantic City. New Mexico:  $73^{\circ}$  at La Mesilla. New York:  $48^{\circ}$  at \*Friendship and  $45^{\circ}$  at Rochester. North Carolina:  $68^{\circ}$  at \*Franklin and  $66^{\circ}$  at Wilmington. Ohio:  $52^{\circ}$  at Cincinnati. Oregon:  $57^{\circ}$  at Roseburg and Portland. Pennsylvania:  $52^{\circ}$  at Pittsburg. Rhode Island:  $49^{\circ}$  at Newport. South Carolina:  $67^{\circ}$  at Charleston. Tennessee:  $65^{\circ}$  at Memphis. Texas:  $93^{\circ}$  at \*Fort Ringgold and  $85^{\circ}$  at Rio Grande City. Utah:  $51^{\circ}$  at Salt Lake City. Vermont:  $40^{\circ}$  at \*Charlotte and  $37^{\circ}$  at Burlington. Virginia:  $60^{\circ}$  at Lynchburg. Washington Territory:  $53^{\circ}$  at Olympia. West Virginia:  $52^{\circ}$  at Morgantown. Wisconsin:  $52^{\circ}$  at \*Neillsville and  $37^{\circ}$  at Milwaukee. Wyoming:  $56^{\circ}$  at Cheyenne.

Those marked with a star (\*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

*Minimum Temperatures.*—Alabama:  $23^{\circ}$  at \*Green Springs and  $21^{\circ}$  at Montgomery. Arizona:  $4^{\circ}$  at Fort Apache. Arkansas:  $8^{\circ}$  at \*Mount Ida and  $18^{\circ}$  at Little Rock. California:  $3^{\circ}$  at \*Truckee and  $18^{\circ}$  at Campo. Colorado:  $-33^{\circ}$  at \*Ft. Lewis and  $-32^{\circ}$  at Pike's Peak. Connecticut:  $-20^{\circ}$  at \*Mystic and  $-5^{\circ}$  at New Haven. Dakota:  $-55^{\circ}$  at \*Fort Stevenson and  $-14^{\circ}$  at St. Vincent. Delaware:  $0^{\circ}$  at \*Dover and  $12^{\circ}$  at Delaware Breakwater. District of Columbia:  $-14^{\circ}$  at Washington. Florida:  $29^{\circ}$  at Pensacola. Georgia:  $18^{\circ}$  at Atlanta. Iowa:  $-40^{\circ}$  at \*Vail and  $-25^{\circ}$  at Dubuque. Idaho:  $1^{\circ}$  at \*Ft. Lapwai and  $13^{\circ}$  at Boise City. Illinois:  $-32^{\circ}$  at \*Elmira and  $-15^{\circ}$  at Champaign. Indiana:  $-13^{\circ}$  at \*Spiceland and  $-6^{\circ}$  at Indianapolis. Indian Territory:  $-17^{\circ}$  at Fort Supply. Kansas:  $-21^{\circ}$  at \*Fort Wallace and  $-18^{\circ}$  at Dodge City. Kentucky:  $0^{\circ}$  at \*Bowling Green and  $8^{\circ}$  at Louisville. Louisiana:  $23^{\circ}$  at Shreveport. Maine:  $-18^{\circ}$  at \*Orono and \*Gardiner and  $-1^{\circ}$  at Eastport. Maryland:  $-17^{\circ}$  at \*Woodstock and  $-6^{\circ}$  at Baltimore. Massachusetts:  $-21^{\circ}$  at \*Billerica and  $-2^{\circ}$  at Boston. Michigan:  $-26^{\circ}$  at Marquette and Escanaba. Minnesota:  $-44^{\circ}$  at St. Vincent. Mississippi:  $23^{\circ}$  at Fayette and  $26^{\circ}$  at Vicksburg. Missouri:  $-24^{\circ}$  at \*Ashley and  $-9^{\circ}$  at St. Louis. Montana:  $-32^{\circ}$  at Fort Keogh. Nebraska:  $-32^{\circ}$  at \*De Soto and  $-27^{\circ}$  at North Platte. Nevada:  $6^{\circ}$  at Pioche. New Hampshire:  $-30^{\circ}$  on summit of Mount Washington and  $-22^{\circ}$  at \*Grafton. New Jersey:  $-24^{\circ}$  at \*Atco and  $0^{\circ}$  at Atlantic City. New Mexico:  $-9^{\circ}$  at Santa Fe. New York:  $-30^{\circ}$  at \*Madison Barracks and  $-10^{\circ}$  at Albany. North Carolina:  $5^{\circ}$  at \*Lenoir and  $11^{\circ}$  at Charlotte. Ohio:  $-17^{\circ}$  at Westerville and  $-3^{\circ}$  at Columbus. Oregon:  $6^{\circ}$  at \*Ft. Klamath and  $8^{\circ}$  at Umatilla. Pennsylvania:  $-22^{\circ}$  at \*Well-boro and  $3^{\circ}$  at Pittsburg. Rhode Island:  $5^{\circ}$  at Newport. South Carolina:  $23^{\circ}$  at \*Aiken and  $30^{\circ}$  at Charleston. Tennessee:  $1^{\circ}$  at \*Rugby and  $9^{\circ}$  at Knoxville. Texas:  $-3^{\circ}$  at Graham. Utah:  $-9^{\circ}$  at \*Coalville and  $2^{\circ}$  at Salt Lake City. Vermont:  $-26^{\circ}$  at \*Woodstock and  $-13^{\circ}$  at Burlington. Virginia:  $-18^{\circ}$  at \*Mount Solon and  $-8^{\circ}$  at Fort Whipple. Washington Territory:

—2° at Dayton. *West Virginia*: —17° at \*Flemington and —2° at Morgantown. *Wisconsin*: —10° at \*Neillsville and —30° at La Crosse. *Wyoming*: —34° at Fort Petterman and —12° at Cheyenne.

Those marked with a star (\*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

*Ranges of Temperature at Signal Service Stations.*—Monthly ranges in general varied from 40° to 80° over the country east of the Rocky Mountains. Ranges less than 50° occurred in the following districts: New England and Middle States, along the immediate coasts; throughout the South Atlantic and East Gulf States; in the West Gulf States east of a line including the stations of Galveston, Shreveport and Little Rock; throughout the Lower Lake region and the lower peninsula of Michigan; in central Tennessee; within the immediate region of the Ohio river and throughout the Middle Plateau and Pacific coast regions. The smallest ranges were: San Francisco, 19°; Key West, 23°; Portsmouth, N. C., 26; Sacramento, 29°; Olympia, 30°; Sandy Hook, 32°; Portland, Or., 33°; Smithville, Los Angeles and San Diego, 34°; Punta Rassa, 35°; Charleston, 37°; Portland, Me., Umatilla, Augusta, Savannah, Wilmington and Cape May, 38°; Detroit, Wood's Holl, Mobile, Jacksonville and Winnemucca, 39°. The largest were Uvalde, Tex., 87°; Camp Thomas, Ariz., 84°; St. Vincent, Minn., 79°; Fort Custer, Mont., and Concho and Fort Davis, Tex., 78°; Forts Keogh and Buford, 77°; Forts Gibson and Supply, Ind. Ty., 75°. The daily ranges varied in the different districts as follows: New England, from 19° at Thatcher's Island to 43° at Burlington; Middle States, 25° at Chincoteague, Cape May and Sandy Hook to 36° at Cape Henry; South Atlantic States, 24° at Charleston and Fort Macon to 30° at Augusta and Wilmington; East Gulf States, 14° at Key West to 32° at Montgomery; West Gulf States, 24° at New Orleans to 46° at Corsicana; Ohio valley and Tennessee, 27° at Louisville to 42° at Morgantown; Lower Lakes, 23° at Detroit to 38° at Cleveland; Upper Lakes, 30° at Alpena to 45° at Milwaukee; Upper Mississippi valley, 35° at St. Paul to 46° at Davenport and Keokuk; Red River of the North valley, 34° at Moorhead to 35° at St. Vincent; Missouri valley, 29° at Omaha to 42° at Leavenworth; Texas, 34° at Brownsville to 53° at Castroville and Uvalde; Eastern Rocky Mountain slope, 36° at Fort Sill to 51° at Deadwood; Rocky Mountains, 30° at Eagle Rock to 47° at Cheyenne; Middle Plateau, 25° at Pioche and Salt Lake City to 30° at Winnemucca; Southern Plateau, 34° at Yuma to 48° at Florence, Tucson and El Paso; Pacific coast regions, 14° at San Francisco and 17° at Portland, Or., to 45° at Campo.

*Frost*—Was reported as almost of daily occurrence from all stations north of the 35th parallel. Southward of that line, in the various States, on the following dates: South Carolina, 12th, 13th, 26th to 30th; Georgia, 2d, 3d, 7th, 12th, 13th, 15th, 16th, 22d, 23d, 25th to 29th; Florida, western portion, 1st, 2d, 3d, 12th, 24th to 29th; eastern portion, north of Punta Rassa, 26th, 28th; Alabama, 2d, 7th, 12th, 13th, 15th, 25th to 29th; Mississippi, 1st, 2d, 7th, 9th, 11th, 12th, 15th, 22d, 23d to 26th, 29th; Louisiana, 1st, 2d, 8th, 11th, 12th, 24th to 26th; New Orleans, 31st, it is estimated that one-half of the orange crop has been destroyed by freezing, and a large number of the young trees killed, cotton and sugar crops have also suffered to a great extent; Texas, 1st to 29th; southern New Mexico, 7th, 8th, 9th, 18th, 19th, 30th, 31st; southern Arizona, 1st, 4th, 5th, 6th, 7th, 17th, 18th; southern California, 3d, 7th, 9th, 10th, 12th, 18th, 27th, 28th.

*Ice*.—Its formation in the northern sections of the country is fully considered under the head of "Ice in Rivers and Harbors." To the southward of the 33d parallel it formed of slight thickness in the various States on the following dates: Georgia, 1st, 2d, 3d; northwestern Florida, 23d, 24th, 25th; Alabama, 1st, 9th, 12th; Mississippi, 9th, 10th, 11th, 22d to 26th; Louisiana, 1st, 2d; Texas, 1st to 20th, 22d to 31st; Arizona, 1st, 5th, 7th to 11th, 23d, 24th.

## PRECIPITATION.

The distribution of rain-fall for January, 1881, is shown on chart No. III, as determined from the regular Signal Service stations and about 450 reports of army post surgeons and voluntary observers. The table on the chart shows the average precipitation for each district, as compared with that of the present month. An excess of rain or snow-fall has occurred in the districts on the Atlantic and East Gulf coasts, varying from 3.80 inches in Florida to 0.83 inches in New England. In the Middle and North Pacific coast region the excess has ranged from 2.61 to 2.16, while the greatest deficiency is reported from the South Pacific coast region, where it amounts to 1.26 in. In Missouri, Tennessee and the Ohio valley and the Lower Lake region, the amount of rain and snow-fall has been from one-half to one inch less than the average for the month, and in all other districts not previously named there has been a slight excess, except, possibly, the region lying south of the Platte river and north of Texas. In this region the stations are so limited in number that it is not possible to give full and accurate information, but the indications are that the rain-fall has been very slight in this region.

*Special Heavy Rains.*—3rd, Ft. Barracas, Fla., 4.75 inches. 3rd and 4th, Pensacola, 3.76; Vicksburg, 3.66; Fayette, Miss., 2.70. 5th and 6th, White Plains, N. Y., 3.20. 8th, Jacksonville, 3.08. 8th and 9th, Cedar Keys, 4.97; St. Augustine, Fla., 3.93. 9th and 10th, Freehold, N. J., 4.06; Fall River, Mass., 4.60; White Plains, N. Y., 3.00; Barnegat, 3.87;



Atlantic City, 3.12. 10th, Newport, R. I., 3.08; Boston, 2.86; New London, 4.01. 10th and 11th, Lawrence, Mass., 4.40; Eola, Or., 3.12; Ft. Stevens, Or., 5.15. 13th and 14th, Ft. Bidwell, Cal., 7.00. 14th, Forsyth, Ga., 2.15. 16th, Ft. Gaston, Cal., since 11 a. m. of the 11th, 14.49 steady rain, wind SSE. 17th and 18th, Ft. Stevens, Or., 3.15. 15th and 19th, Elsworth, N. C., 2.00; Vicksburg, 5.78; Atlanta, 4.18. 19th and 20th, Forsyth, Ga., 3.86; Elsworth, N. C., 2.75; Augusta, 4.18; Aiken, S. C., 4.05. 20th and 21st, Woodstock College, Md., 2.20. 21st and 22nd, White Plains, N. Y., 4.00. 24th, Jacksonville, 2.18. 27th and 29th, Fort Ringgold, Texas, 3.22. 28th and 29th, Presidio, San Francisco, Cal., 3.60; Alcatraz Island, Cal., 5.82. 29th, San Francisco, 4.67. 29th and 30th, Sacramento, 4.01; Fort San Jose, Cal., 3.64; Boncacia Barracks, Cal., 3.92; Angel Island, Cal., 6.68; Oakland, Cal., 8.35. 31st, Fort Stevens, Or., 2.75.

*Largest Monthly Rain-falls.*—Emigrant Gap, Cal., 22.19 inches; Alta, Cal., 21.00; Camp Gaston, Cal., 20.78; Cisco, Cal., 16.11; Colfax, Cal., 15.59; Calistoga, Cal., 15.58; Ft. Stevens, Or., 14.63; Napa, Cal., 11.69; Roseburg, 11.60; New Orleans, 11.15; White Plains, N. Y., 10.50; Oakland, Cal., 10.48; Ft. Bidwell, Cal., 10.00; Ft. Canby, Wash. Ty., 9.84; Auburn, Cal., 9.61; Red Bluff, 9.40; Angel Island, Cal., 9.39; Santa Cruz, Cal., 9.38; Cedar Keys, Fla., 9.36; Jacksonville, 9.12; Yosemite valley, Cal., 9.10; Ft. Barrancas, Fla., 8.96; Olympia, Wash. Ty., 8.96; Neah Bay, Wash. Ty., 8.78; Alcatraz Island, Cal., 8.76; Augusta, Ga., and San Francisco, 8.69; Portland, Or., 8.57; Barnegat, 8.43; Elsworth, N. C., 8.38; Atlanta, Ga., 8.35; Petaluma, Cal., 8.13; Freehold, N. J., and Hector, N. Y., 7.85; Aiken, S. C., 7.72; Mobile, 7.62.

*Smallest Monthly Rain-falls.*—Mojave, Texas Hill, Maricopa, Casa Grande, Benson, Phoenix, Florence and Yuma, Ariz., and White Water and Mammoth Tank, Cal., none; Ft. Abraham Lincoln, Dak., trace; Silver City, N. M., 0.02 inch; Camp Thomas, Ariz., 0.03; La Mesilla, N. M., 0.04; Tucson and Grant, Ariz., 0.05; Wickenburg and Ft. Verde, Ariz., 0.07; Pantana, Cal., 0.08; Ft. Randall, Dak., 0.10; McCavitt, Tex., 0.12; St. Vincent, Minn., 0.13; Tecoma, Nev., Dodge City and Leavenworth 0.15; Ft. Totten, Dak., Ft. Wingate, N. M., Prescott, Ariz., North Platte and Frankford, Mo., 0.16; Ft. Wallace and Yates Center, Kan., 0.19; Uvalde, Stockton and Apache, 0.20; Concho, 0.22; Anaheim, Cal., 0.25; Halleck, Nev., and Ashley, Mo., 0.31; Ft. Supply, Ind. Ty., 0.32; El Paso and Brackettville, Tex., and Golconda, Nev., 0.35; Coleman, Tex., and Cheyenne, 0.36; Mason, Tex., 0.37; Santa Fe, 0.38; Ravenna, Cal., 0.39; Ft. Hartsuff, Neb., Ft. Davis, Tex., and Dover, Del., 0.40; Ft. Sheridan, Neb., 0.42; Graham, Tex., 0.43; Leavenworth, 0.44; Terrace, Nev., and Castroville, Tex., 0.45; Fts. Elliott and Stevenson, 0.47; Jacksboro, Tex., 0.48; Denver and St. Louis, 0.49; Keokuk, 0.50; San Diego, Cal., and Peoria Ill., 0.52; Toledo, 0.54; Socorro, N. M., 0.55; Ft. Meade, Dak., and Elko, Nev., 0.56; Newhall, Cal., and Creswell, Kan., 0.57; San Antonio, Tex., 0.58; Topeka, Kan., Moorhead, Min., and Sumner, Cal., 0.60; Lawrence, Kan., and Omaha, 0.61.

*Rainy Days.*—The number of days on which rain or snow has fallen varies as follows: New England, 7 to 18; Middle Atlantic States, 11 to 16; South Atlantic States, 10 to 18; Eastern Gulf States, 11 to 16; Western Gulf States, 6 to 13; Ohio valley and Tennessee, 13 to 23; Lower Lake region, 10 to 24; Upper Lake region, 10 to 20; Upper Mississippi valley, 3 to 18; Missouri valley, 8 to 17; Valley of the Red River of the North, 6 to 11; Texas, 3 to 13; Rocky Mountains, 1 to 12; Middle Plateau, 6 to 18; Southern Plateau, 0 to 3; California, 3 to 11; Oregon, 10 to 19; Washington Territory, 12 to 19.

*Cloudy Days.*—The number varied in New England from 3 to 16; Middle Atlantic States, 10 to 16; South Atlantic States, 13 to 20; Eastern Gulf States, 8 to 21; Western Gulf States, 9 to 16; Ohio valley and Tennessee, 14 to 22; Lower Lake region, 15 to 25; Upper Lake region, 6 to 18; Upper Mississippi valley, 9 to 17; Missouri valley, 7 to 15; Valley of the Red River of the North, 4 to 6; Texas, 2 to 21; Rocky Mountains, 1 to 21; Middle Plateau, 10 to 16; Southern Plateau, 2 to 5; California, 5 to 10; Oregon, 12 to 19.

*Rain or Snow from a Cloudless Sky.*—Leavenworth, 21st; Omaha, 21st, 22d; Cincinnati, 27th; Lewiston, Idaho, 28th; Burlington, Vt., 30th.

*Snow*—was reported in the various districts on the following days: *New England.*—3rd to 12th, 14th, 17th, 18th, 19th, 21st, 22nd, 26th to 31st. *Middle States.*—1st to 6th, 9th to 12th, 14th, 16th, 19th, 21st to 31st. *South Atlantic States*—except southern Georgia, 1st to 3rd, 24th, 25th. *East Gulf States*—except Florida, 1st, 2nd, 23rd, 24th. *West Gulf States*—including Texas, 1st to 3rd, 5th, 8th to 11th, 17th, 19th, 20th, 22nd to 24th; at New Orleans 4 inches fell on the 24th, being the greatest depth since 1852, when sleighing was indulged in; Melissa, Tex., "have had so far seven snow storms this winter, which is five more than has ever occurred in any past winter, but frequently one storm has given a greater depth than the combined storms of this season." *Tennessee.*—1st, 2nd, 4th, 5th, 6th, 9th to 14th, 21st to 26th. *Ohio valley.*—3rd to 19th, 21st to 31st. *Lower Lakes.*—3rd to 17th, 21st to 31st. *Upper Lakes.*—1st to 16th 20th to 31st. *Upper Mississippi valley.*—4th to 9th, 13th to 16th, 20th to 31st. *Missouri valley.*—1st to 16th, 20th to 31st.

*Red River of the North valley.*—1st, 5th, 7th, 8th, 9th, 12th to 15th, 29th to 31st. *Rocky Mountain.*—1st to 17th, 20th to 31st. *Southern Plateau.*—2nd, 3rd, 4th, 6th, 14th, 16th, 17th, 18th, 20th, 30th. *Middle Plateau.*—1st, 4th to 11th, 13th to 16th, 25th, 26th. *Northern Plateau.*—3rd, 4th, 7th, 9th, 10th, 16, 19th, 26th. *California.*—9th, 10th, 13th, 15th, 16th, 17th, 19th, 25th, 26th. *Oregon and Washington Territory.*—2nd, 3rd, 9th to 15th, 17th, 24th to 28th, 31st.

*Greatest Monthly Snow-falls.*—Cisco, Cal., 173.50 inches; Summit, Cal., 45; Niles, Mich., 43; Newport, Vt., 37.25; Woodstock, Vt., 36.30; Cornish, Me., 36; Emigrant Gap, Cal., 35; Rowe and Westborough, Mass., 34; Grafton, N. H., 33; Truckee, Cal., 31.50; Troy, N. Y., 31; Lansing, Mich., 30.40; Trinidad, Col., 29; New Corydon, Ind., 28.80; Antrim, N. H., 28.50; Deer Park, Md., 26.50; Ogden, Utah, 26.25; Cooperstown, N. Y., 25; Friendship, N. Y., 23.75; Dyberry, Pa., 23.50; Little Mountain, Ohio, 22.50; Nora Springs, Iowa, 20; Wellsboro, Pa., 19.92; Ripon, Wis., 19; Patterson, N. J., 18.25; Rockford, Ill., 17.25.

*Snow on Ground at End of Month.*—No reports of this condition were received from any station south of the 35th parallel, but northward of that line the distribution is shown in the various States and Territories as follows: *Maine*, 7 to 24 inches. *New Hampshire*, 30 to 48. *Vermont*, 20 to 36. *Massachusetts*, 1 on the coast to 36 in the interior. *Connecticut*, 3 to 8. *New York*, 4 to 40. *New Jersey*, 6 to 12. *Pennsylvania*, 3 to 25. *Maryland*, 0.30 to 16. *Virginia*, 4 to 8. *West Virginia*, 0 to 3. *Ohio*, 1 to 9. *Indiana*, 6 to 15. *Illinois*, 1 to 16. *Michigan*, 15 to 42. *Wisconsin*, 5 to 30. *Iowa*, trace to 20. *Minnesota*, 3 to 35. *Tennessee*, trace at Memphis. *Indian Territory*, trace at Ft. Gibson. *Arkansas*, Ft. Smith, snow on ground without intermission since November 15th, 1880. *Nebraska*, 1 to 6; Austin, 31st, snow still on ground since the early part of December, a condition which has not obtained before in the past 7 years, especially in the Loup valley. *Dakota*, 3 to 9. *Colorado*, 4 to 18. *Montana*, 12 to 24.

## RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges, as follows: *New England*, 64 to 75; *Middle Atlantic States*, 70 to 84; *South Atlantic States*, 71 to 85; *Eastern Gulf States* 73 to 81; *Western Gulf States*, 64 to 82; *Ohio Valley and Tennessee*, 69 to 80; *Lower Lake region*, 66 to 83; *Upper Lake region*, 68 to 81; *Upper Mississippi valley*, 71 to 77; *Missouri valley*, 71 to 92; *Valley of the Red River of the North*, 69 to 93; *Texas*, 52 to 77; *Middle Plateau*, 48 to 64; *Southern Plateau*, 39 to 47; *California*, 63 to 82; *Oregon*, 78 to 87. *High stations* report the following percentages not corrected for altitude: *Mt. Washington*, 74.2; *Pike's Peak*, 69.8; *Denver*, 58.5; *Cheyenne*, 57.5; *Eagle Rock*, 77.7; *Santa Fe*, 60.0.

## WINDS.

The prevailing direction of the wind during the month of January, 1881, are shown by the arrows flying with the wind, on chart No. II. The prevailing direction was *northwest to north* on the Atlantic coast, in the Southern States and at stations on the eastern slope of the Rocky Mountains. *North to east* winds prevailed in California and Arizona, and *east to south* winds in the North Pacific coast region, and at stations in Nevada and Idaho. In the Lake region the prevailing direction was from *northwest to southwest*, except in the eastern portion, where they were generally from the *south*. The prevailing direction of wind at Pike's Peak and Denver, was from the *southwest and south*, respectively. The prevailing direction on Mount Washington was *northwest*.

*Total Movements of the Air.*—The following are the largest total movements at Signal Service stations: *Mt. Washington*, 28,705 miles; *Thatcher's Island*, 14,102; *New Shoreham*, 12,629; *Cape May*, 11,852; *Portsmouth, N. C.*, 11,489; *Wood's Holl*, 11,267; *Indianola*, 11,107; *Cape Hatteras*, 10,876; *Kittyhawk*, 10,740; *Delaware Breakwater*, 10,631; *Eastport*, 10,107; *Barnegat*, 9,974; *Cheyenne*, 9,855; *Chincoteague*, 9,277; *Sandy Hook*, 9,214; *Coleman*, 9,077. The *smallest* are: *La Mesilla*, 1,794 miles; *Phoenix*, 1,797; *Florence*, 1,839; *Visalia*, 1,890; *Roseburg*, 1,973; *Missoula*, 1,976; *Lynchburg*, 2,134; *Silver City*, 2,500; *Augusta, Ga.*, 2,510; *Boise City*, 2,790; *Dubuque*, 2,810; *Helena*, 2,876; *Tucson*, 2,981; *Uvalde*, 2,991; *Los Angeles*, 3,258.

*High Winds.*—Winds of 50 miles and above were observed, as follows: On summit of *Mt. Washington*, 1st to 10th, 12th to 15th, 17th, 18th, 20th to 31st; the highest wind was 130 miles S. on the 10th and NW. on 29th. On summit of *Pike's Peak*, 4th, 9th to 12th, 26th to 30th, with a maximum of SW. 88 miles on the 28th. *Umatilla, NE.* 58 on the 26th. *Cheyenne, W.* 52, 11th. *North Platte, N.* 52, 5th, *Ft. Elliott, NW.* 52, 5th. *Kittyhawk, N.* 56, 14th. *Del. Breakwater, N.* 52, 14th. *Cape May, NW.* 56, 27th. *Wood's Holl, SE.* 56, 10th. *Thatcher's Island, E.* 66, 21st. *New Shoreham, NE.* 60 21st.

*Local Storms.*—*Santa Ana valley, Cal.*, 21st, p. m., violent wind-storm, destroying buildings and fences, delaying trains and prostrating telegraph poles. *Petersburg, Va.*, 19th, very heavy wind-storm; large warehouse destroyed and other property more or less damaged.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily indications for January, with the telegraphic reports for the succeeding twenty-four hours, shows the general average percentage of verifications to be 82.7 per cent. The percentages for the four elements are: Weather, 90.1; Direction of the Wind, 79.7; Temperature, 81.4; Barometer, 78.4 per cent. By geographical districts they are: for New England, 80.5; Middle States, 84.0; South Atlantic States, 86.2; Eastern Gulf States, 78.0; Western Gulf States, 82.2; Lower Lake region, 84.0; Upper Lake region, 86.5; Tennessee and the Ohio valley, 81.9; Upper Mississippi valley, 84.1; Lower Missouri valley, 78.2; Northern Pacific coast region, 84.0; Central Pacific coast region, 90.0; Southern Pacific coast region, 93.0. There were 264 omissions to predict out of 3,813 or 6.92 per cent. Of the 3,549 predictions that have been made, 144, or 4.06 per cent. are considered to have entirely failed; 140, or 3.94 per cent. were one-fourth verified; 523, or 14.74 per cent. were one-half verified; 416, or 11.72 per cent. were three-fourths verified; 2,326, or 65.54 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

*Cautionary Signals*—147 Cautionary Signals were displayed during the month, of which 124, or 84.3 per cent., were fully justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. 37 Off-shore Signals were displayed, of which 31 or 83.8 per cent. were fully justified, 35 or 94.6 per cent. justified as to direction and 32 or 86.4 per cent. were justified as to velocity. Fifteen of the Off-Shore were changed from Cautionary. 184 Signals of both kinds were displayed, of which 155 or 84.2 per cent. were fully justified. The above does not include signals ordered at display stations on the New England coast, where the velocity is only estimated. Eleven signals were ordered late.

## NAVIGATION.

*Stage of Water in Rivers.*—In the table on the right-hand side of chart No. III are given the highest and lowest stages of water, as observed on the Signal Service river-gauges, during the month of January, 1881. The Arkansas, and the Mississippi at St. Louis, experienced but little change during the month. There was a marked rise in the Red, and that portion of the Mississippi from Cairo to Vicksburg, from 25th to 31st, reaching the highest water on the latter date at all stations except Cairo, where it occurred on the 28th. In the Ohio, Cumberland, Tennessee and Savannah rivers, the highest stage was reached between the 20th and 25th, and as early as the 8th, in the Monongahela, at Morgantown. The Williamette, at Portland, Or., rose very rapidly on the 14th and 15th, flooding lower portion of city and a large section of the surrounding country. The Sacramento, at Sacramento, rose suddenly on the 29th, and by 11 a. m. of the 31st, reached 26 feet above low water mark; 0.5 inch higher than ever before recorded. At Red Bluff, the river rose rapidly on the 14th and 29th, but reached its highest stage on the 31st, twenty-four feet above low water mark.

*Ice in Rivers and Harbors.*—The following items show the condition of the navigable waters throughout the United States, during the month of January, 1881, in respect to the formation of ice. The Missouri and that portion of the Mississippi River from Keokuk northward have remained frozen over during the month. At all stations on the lakes ice has accumulated to a considerable thickness and extends to long distances from shore, prohibiting all navigation. From other sources the following notes are given in detail: *Columbia River.*—Portland, 22nd, navigation closed between city and Cascade because of ice, but open again on the 31st; 24th, considerable floating ice in lower portion of river; 25th, large quantities of ice gorged at Willow Bar. *Umatilla River.*—Umatilla, navigation closed during month because of floating ice. *Snake River.*—Lewiston, Idaho, 1st, full of floating ice. *Clear Water River.*—Lewiston, Idaho, 1st, full of floating ice; 17th, considerable floating ice. *Mississippi River.*—St. Paul, 31st, ice 30 inches thick. Dubuque, 31st, ice 18 to 32 inches. Keokuk, 17th, teams crossing on ice, first time this season. Clinton, Iowa, 31st, ice 24 to 30 inches. St. Louis, 1st, river south of bridge kept clear of ice by tugs; north of bridge ice 14 inches thick. Cairo, floating ice, 24th to 26th; clear of ice, 29th. Memphis, floating ice, 1st to 31st; on the 10th so heavy as to practically close navigation; 14th, steamer loaded with cotton and valued at \$139,000, was sunk at wharf; supposed to be caused by floating ice. *Ohio River.*—Cairo, 15th, ice gorge broke; 19th, navigation resumed, boat left for Cincinnati. Louisville, 9th, ice breaking up; 10th to 15th, floating ice, heaviest for many years; 20th, breaking away from banks and large quantities passing down river; 21st, full of ice from breaking of gorge at Madison and from the Licking and Kentucky rivers; 22nd, two steamers attached to docks "stove in" by floating ice; 23rd, canal open and boat came from Portland; 28th to 31st, full of floating ice. Cincinnati, 8th, ice broken up, carrying away many coal barges; causing a loss estimated at \$60,000; 13th, navigation resumed; 14th to 20th, small quantities of floating ice; 21st, filled with ice by breaking up of gorges from above. Vevay, Ind., 3rd, frozen over, people crossing in large numbers; 8th, ice soft and unsafe for crossing; 11th, breaking up and running out; 12th, full of floating ice; 17th, first steamer since breaking up of ice passed down the river; 20th, very heavy floating ice, difficult for boats to pass; 23rd, boats running quite regularly. Portsmouth, 1st, teams crossing on ice; 7th, broke up with considerable destruction to shipping; 8th to 20th, heavy floating ice



impeding navigation. Wellsburg, W. Va., 8th, ice broke up about midnight. Pittsburg, 21st, general breaking up of ice in early morning; water rising 6 to 8 inches an hour; several pike bridges gave way and were destroyed. *Big Miami River*.—Piqua, Ohio, 20th, in many places frozen solid to the bottom. *St. Clair River*.—Port Haron, 1st, frozen over; people crossing on foot; 12th, teams crossing to Canadian shore. *Lake Michigan*.—Milwaukee, 30th, steamer "St. Albans," of Northern Transit Line Co., sunk by floating ice at a point about 20 miles northeast of station; crew and passengers saved, cargo and vessel a total loss. *Lake Geneva*.—Bloomfield, Wis., 31st, ice 30 inches in thickness. *Grand River*.—Ft. Gibson, 11th, frozen over; teams and people crossing. *Kansas River*.—Lawrence, 17th, ice 14th to 20 inches thick. *Arkansas River*.—Little Rock, 1st, frozen over; 6th, ice breaking up; 19th, clear of ice and rising very rapidly. Pine Bluff, 1st, steamer "Plow Boy" sunk by floating ice, and steamer "Katie Hooper" frozen in. Fort Smith, 3rd, frozen over; people crossing. *Poteau River*.—Fort Smith, Ark., frozen over; people crossing. *Red River*.—Shreveport, 1st, shore-ice formed. *Monongahela River*.—Morgantown, 1st to 5th, frozen over; 6th, ice broke up and gorged heavily; 7th, gorge gave way and destroyed river gauge; 27th, frozen over again; 31st, still frozen. Elizabeth, Pa., 18th, ice gorge started and carried away large portion of dam. *James River*.—Richmond, Va., 11th, schooner "Ella H. Barnes" parted anchors and was carried down by the ice. *Core Sound*.—Cape Lookout, 1st, considerable ice formed; a very unusual occurrence. *Delaware Bay*.—Del. Breakwater, 1st, floating ice in harbor; 2nd, harbor packed with floating ice, causing vessels to drag anchor; telegraph cable broken; 3rd, ice passing out; 5th to 31st, floating ice. Cape May, 28th, floating ice. *Little Egg Harbor, N. J.*—3rd, ice breaking up in Sound; 23rd, heavy floating ice; 24th, ice in lower portion of bay remains solid; 25th, ice forming in bay and cove; 27th, bay and cove blocked with ice. *Chincoteague Bay*.—Chincoteague, 29th, frozen over. *Delaware River*.—Philadelphia 31st, obstructed by ice throughout month, seriously interrupting navigation. *Susquehanna River*.—Cat-awissa, Pa., 31st, north branch remained closed during the month, ice 19 inches in thickness. *Chesapeake Bay*.—Baltimore, 1st, ice very heavy as far down as Sandy Point, channel in bay and harbor kept open by ice boats; 4th, oyster trade suffering severely, owing to ice, dredging almost entirely suspended; 8th, very large number of oyster boats frozen in at different points, crews suffering severely from cold and scarcity of fuel; 12th, ice blockade broken up, no longer any obstruction; 15th, ice nearly all passed out; 19th, large quantities of drift ice obstructing river and harbor; 20th, navigation still dangerous, owing to floating ice; 22nd, winds and tides blocked up river and harbor with ice, stopping navigation; 23rd, nearly clear; 24th, river and harbor free, but smaller towns down the bay are in a critical condition from blockade, creeks and rivers emptying into the Bay are completely closed, imprisoning large fleets of oyster boats; 28th, new ice formed in harbor and river to a depth of two inches, channel kept clear by ice boats. Portsmouth, Va., 20th, incoming boats report immense fields of ice in Bay, seriously obstructing navigation. *Hudson River*.—Ardenia, N. Y., 31st, ice 18 to 20 inches in thickness. Poughkeepsie, N. Y., 1st, river for miles south frozen solid. *Long Island Sound*.—Sandy Hook, 14th, 1000 feet of wharf carried away by the battering of out flowing ice; ocean frozen solid from point of the Hook to the main ship channel, ice 12 to 14 inches thick; navigation extremely perilous owing to endless mass of floating ice. New Haven, Conn., 1st, steamers arriving report great difficulty in forcing their way through the ice at upper portion of Sound; one continuous ice floe from Sands Point to Hell Gate; from Greensport to Sag Harbor a solid field of ice. *Narragansett Bay*.—Newport, R. I., 29th, ice forming rapidly in harbor; 30th, frozen over, channel free during afternoon; 31st, large quantities of floating ice, sailing vessels frozen in, steamers made usual trips with great difficulty. *New Haven Harbor*.—New Haven, 1st, frozen over, first time since February, 1875; serious obstruction to navigation, large fleet of vessels frozen in; navigation closed to all but steamers; oyster famine threatened; 31st, harbor still blocked with ice, but channel kept clear by tugs. *Connecticut River*.—Hartford, Conn., 31st, ice 18 inches in thickness. *Buzzard's Bay*.—Wood's Holl, 4th, ice covers eastern portion of bay. *Boston Harbor*.—Boston, 3rd, portion of harbor between city proper and south Boston frozen over, people crossing; 8th, ice extends over a considerable portion of harbor; 28th, great quantities of floating ice. *Lake Champlain*.—Burlington, Vt., 1st, inside of breakwater frozen over; 3rd, harbor closed; 4th, the broad part of lake frozen in many places; 10th, heavy floating ice outside of harbor; 13th, ice in lake passed out; 16th, lake entirely frozen over; harbor closed from 3rd to 31st. Charlotte, Vt., 16th, lake partly frozen over, ice moving slowly; 17th, ice passed out; 18th, entirely closed over except a few open spots; 20th, entirely closed, ice boats out, good crossing on foot; 25th, ice strong enough for teams to cross; 31st, little or no travel on ice because of deep snow.

*Floods*.—Destruction of property and serious interruption to travel and telegraphic communication, from heavy precipitation and the sudden melting of heavy snow, has been quite a marked feature of the month in portions of the South Atlantic and East Gulf States, in the Ohio valley and in the Northern Plateau and Pacific coast regions. Portland, Or., 11th, heavy rains, telegraph lines all down; 12th, Willamette river rising 4 inches per hour, immense amount of driftwood passing; heavy drift in the Molalla river and several bridges carried away; 14th, Columbia river rising rapidly covering nearly all of the lower portion of the city, at Pacific Docks \$40,000 of wheat damaged; 15th, river still rising and filled with driftwood, large portion of country inun-

dated by overflow of Willamette river, telegraph lines still useless; 18th Klamath and other rivers higher than during the big flood of 1861, mails packed on foot, roads impassable to animals, several bridges washed away on the Scott and Kalmath rivers, great loss to individuals and companies. Mehama, Or., 11th, Santiam river highest for 8 years, bridges washed away, all communication stopped; trees uprooted along the banks and carried into the channel, which soon became a floating mass of wrecks and logs. The Dalles, Or., 13th, great quantities of logs, railroad ties and debris of wrecked bridges floating down the Columbia river. Salem, Or., 13th, several bridges and buildings swept away, roads impassable. Harrisburg, Or., 13th, water within six inches of the high-water mark of 1861, town completely flooded; twenty families routed out of their houses and large number of animals drowned: general destruction of fences and bridges and many large sections of railroad track carried away. Pomeroy, Wash. Ty., 11th, Pataha creek rose 15 feet during day, carrying away fences, corded wood and buildings, several families compelled to seek higher ground for safety. Umatilla, Or., 13th, rapid rise in Umatilla river; at a point 20 miles south of station, whole country submerged; people compelled to flee from their dwellings; great loss to property. Roseburg, Or., 12th, stages and trains delayed by high water; railroad bridge across North Umpqua river washed away; all telegraph lines down; railroad travel ceased; 14th, water reached its highest point, within 3 feet of the flood of 1861. Lewiston, Idaho, 11th, rivers and creeks overflowed; stage routes impassable; Snake river rose 3 feet in 10 hours; several bridges carried away. Sacramento, Cal., 18th, river full of driftwood; 29th, river rose rapidly, reaching 12 feet above low-water mark at 1 p. m.; 30th, 24.5 feet above; 31st, 26 feet at 11 a. m.; during night levees two miles below city broke, flooding all ranches in vicinity; at Washington, on the opposite side of the river, levees broke both above and below, overflowing all the tule lands. San Jacinto, Cal., 18th, highest water in 12 years. San Francisco, 29th, heaviest storm of rain ever known here; immense pressure of water upon sewers, causing much damage; in lower sections of city cellars and basements flooded and nearly all business houses between Sanson street and the Bay, north of California street, filled with water; no damage to shipping, but all railroad and telegraphic communication along the coast suspended; several miles of the Santa Cruz R. R. washed away and the towns of Napa, Watsonville and Marysville flooded. 30th, the town of Comp Capito, on Saquel Creek, in Santa Cruz Co., washed out to sea, only four houses left standing; the Oroville railroad submerged a long distance; at Windsor, Sonoma Co., 13 inches of rain fell in 70 hours; at Placerville, Eldorado Co., 7.61 inches fell in 24 hours; on the Southern Pacific railroad, eight men were buried alive by a huge land-slide, caused by washing away of embankment. Yosemite Valley, Cal., 30th, very heavy rains, Yosemite Falls and Bridal Veil rose to about their highest points in 48 hours. Visalia, Cal., 30th, all streams rapidly rising, many of which are impassable; 31st, Mill Creek overflowed banks, submerging immediate country. Red Bluff, Cal., 14th, mountain creeks rose suddenly, carrying away bridges and overflowing bottom lands; 22d, river rose rapidly, reaching the 22-foot mark; 31st, river reached highest point of season, viz: 24 feet above low water mark, all low lands flooded, cellars filled with water, fences and bridges washed away, telegraph lines down in all directions, great washouts along railroad tracks and immense land-slides filling up railroad cuts and stopping all communication. Dayton, Ohio, 20th, all streams throughout the Miami valley bank-full, and in many cases overflowing the low lands. McKeesport, Pa., 18th, heavy land-slide, carrying away 100 yards of railroad track. Mingo, Pa., 18th, trestle-work washed away. Greensburg, Pa., trestle-work washed away, and at Davidson's Station railroad track destroyed, all passengers and baggage transferred. Hawkinsville and Monroe, Ga., 20th, roads impassable. Forsyth, Ga., 20th, roads in terrible condition, river rising rapidly and full of floating debris. Macon, Ga., 20th, lower portion of city submerged, people moving about in boats. Rome, Ga., serious washouts. Athens, Ga., 20th, highways impassable, trains blocked by extensive land slides and washouts. Elberton, Ga., 20th, incessant rains for four days, streams overflowed, roads impassable, business suspended. Gainesville, Ga., 20th, almost the whole country roundabout covered by a solid sheet of water. West Point, Ga., 20th, portion of city under water, people passing about in boats. Hamburg, Ga., 20th, town nearly submerged. Richmond, Va., 21st, all mountain streams overflowed, causing considerable damage. Lynchburg, Va., 20th, James River 5 feet above ordinary level; at Columbia the river rose 9 feet, and at Charlottesville 6 feet. Moreauville, Avoyelles Parish, La., 4th, roads impassable, all communication suspended, sugar crop seriously injured and will show a deficit of 25 per cent.

*Droughts.*—Springfield, Ill., 20th, wells and cisterns drying up; 31st, river so low that it has become nearly stagnant and gives forth a bad odor; farmers have been hauling water from city for past two weeks; drought has been general and very severe in the central portion of the state. Peoria, Ill., 25th, much suffering from want of water. Holton, Kan., 31st, month remarkably dry. Lawrence, Kan., 31st, very dry, rain-fall 0.99 inches below the average for the past 13 years. Yates Center, Kan., 31st, driest within the memory of the oldest settler; streams and wells very low; stock driven three miles for water. Creswell, Kan., 31st, wells and springs almost exhausted. "Missouri Weather Service" reports a monthly rain-fall at the central station of 0.39 inches, the smallest recorded since 1837; lowest previous rain-fall was 0.41 inch in 1857 and only twice since 1839 has the January rain-fall been less than 0.50 inch. Mendon, Mass., 31st, much need of

rain, wells and cisterns dry. Auburn, N. H., 31st, wells and cisterns dry in many localities. Woodstock, Vt., 31st, drought throughout month and still continues without abatement; but two families in the city have sufficient water for household purposes; farmers compelled to haul water for stock from long distances.

*High Tides.*—San Francisco, 29th, at 10.30 a. m. 6 inches higher than any previous record.

*Low Tides.*—Newport, R. I., 29th, unusually low, steamer grounded at dock. New London, Conn., 29th, very low, steamship "Massachusetts" went aground in her dock at Stonington; old sailors remark that it is the lowest water for many years.

## TEMPERATURE OF WATER.

*The temperature of water*, as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the left hand side of chart No. III. Owing to ice and breakage of instruments, observations are wanting as follows: Alpena, Buffalo, Chicago, Cleveland, Detroit, Duluth, Escanaba, Grand Haven, Marquette, Milwaukee, Sandusky and Toledo, from 1st to 31st; Burlington, Vt., 2d to 4th, 6th to 31st; Charleston, 3d to 12th; Delaware Breakwater, 1st to 3d, 11th, 12th, 19th, 21st.

## ATMOSPHERIC ELECTRICITY.

*Auroras.*—Faint auroral displays were observed at St. Vincent, Minn., (the most northerly of Signal Service stations) on the 2nd, 21st, 22nd, 23rd, 24th, 26th and 29th. With these exceptions, no display was observed outside New England or south of the 42nd parallel save that of the 31st. The aurora of the 31st was more than ordinarily brilliant and was observed throughout New England and west of the 92nd meridian to western Montana and north of the 45th parallel. The prevalence of cloud in the entire Lake region and Ohio valley, probably prevented its observation in these regions. The following descriptive notes are of interest: Burlington, Vt., "at 7.35 p. m. a most remarkable auroral display was noted. The dark segment extended 25° above the northern horizon, above which the arch of light was seen, being of a white color, deepening into a pale sea green; a faint rose color was noted in the extreme west-northwest. The principal feature of the display was a white, hazy light, deepening, near the eastern horizon, to a pale straw color, and extending from the eastern horizon to the zenith, and ending in the west-northwest, covering half of the heavens with a white canopy. One or two streamers were observed in the north-northwest. The eastern terminus passed to the south of east, and looked not unlike the light seen when the harvest moon is rising. By 8.15 the display had faded away, and only the dark segment and the arch of light remained. At 9 p. m. the sky was overcast, and only a faint green light was to be seen on the northern horizon. At 11 p. m., with a nearly clear sky, a faint emerald green light was seen on the northern horizon, with several streamers in the north-northwest. At midnight these features were still present." The observer at St. Vincent states that it lasted all night, beginning at 7.30 p. m. of the 30th as a bright streak low down, with a faint arch surmounting it, and increasing in extent and brightness till morning, when it showed magnificent streamers like great brushes, with the dark segment high and pronounced. It was again observable during the entire night of the 31st, though mostly obscured by clouds. The observer at Ft. Missoula reports that it extended over about one-fourth of the horizon with an altitude of 45°. It began at 11 p. m., appeared brightest at midnight and ended at 2 a. m. The sky presented the appearance of a fiery dome, bright and very luminous; flames shooting from nearly every part, similar to those issuing from a burning building. Auroras were also observed in the New England States on the 23rd, 24th, 25th, 26th and 27th, but deserve no special mention.

*Atmospheric Electricity Interfering with Telegraphic Communication.*—Accompanying the very severe snow-storm of the 6th, which prevailed over a space of about 800 miles in width along the line of the Union Pacific R. R., between Omaha and Ogden, there was experienced a very positive display of electrical disturbance. For 24 hours the telegraph wires were rendered useless, the intensity being shown by the fact that when the telegraph key was opened a steady electric light burned at the connecting points. According to the records kept by the chief operator of the U. P. R. R. telegraph lines there is but one exception in the past 12 years to the regular yearly occurrence of similar storms between the 5th and 7th of January. At Fort Apache, Ariz., on the 16th, wires could not be worked for a considerable time.

*Zodiacal Light.*—St. Vincent, Minn., 1st, 2nd, 3rd, 6th, 7th, 8th, 21st, 22nd, 24th, 26th, 29th; Little Rock, 25th; Springfield, Ill., 2nd, 17th, 26th, 27th; Nashville, 8th, 25th to 28th; Southington, Conn., 24th; New Corydon, Ind., 1st, 2nd, 11th, 17th; Clinton, Iowa, 26th; Cresco, Iowa, 1st, 17th, 18th; Lawrence, Kan., 1st, 3rd, 12th; Manhattan, Kan., 3rd; Yates Center, Kan., 2nd, 22nd, 24th, 26th, 27th; Somerset, Mass., 16th to 18th, 20th, 22nd to 31st; Cambridge, Mass., 1st, 17th, 18th, 20th, 24th to 29th; Clear Creek, Neb., 1st, 2nd, 3rd, 18th, 25th; Oregon, Mo., 1st, 2nd; Pierce City, Mo., 23rd; Atco, N. J., 19th; Bellefontaine, Ohio, 25th to 28th.

*Thunder-storms.*—None were reported from the northern sections of the country, and but a small number from the southern districts, as will be seen from the following dates: Florence, Tuc-



son and Fort Apache, Ariz., 16th; Camp Grant, Ariz., 17th; Galveston, 2nd; Clarksville, Tex., 28; Memphis, 19th; New Orleans, 2nd, 18th; Key West, 6th, 7th, 8th, 14th; Wilmington, N. C., 6th, 21st; Charlotte, N. C., 5th; Chincoteague, Va., 6th.

## OPTICAL PHENOMENA

*Halos* have been observed with considerable frequency throughout the month in the various districts. Solar halos, with mock suns, have been rather numerous, but not of as marked brilliancy and perfection as those reported in December, 1880. The following stations report from 2 to 4 mock suns on the dates named: Fort Stevenson, Dak., 20th; Fort Totten, Dak., 6th, 7th, 8th; Spiceland, Ind., 12th; Pierce City, Mo., 22nd; Cheyenne, 26th; Yankton, 4th, 6th, 11th, 12th, 13th; St. Paul, 4th; Dubuque, 24th; Logansport, Ind., 27th; Bangor, Me., 16th. Nothing of importance was reported in respect to lunar halos, except the following: Clinton, Iowa, very brilliant; four mock moons, and above the body of the halo appeared the inverted arc of a circle. Fort Bennett, Dak., 22nd, 5:20 a. m., very brilliant lunar corona.

*Polar Bands*.—Prescott, Ariz., 5th; Detroit, 8th; New Corydon, Ind., 2nd, 3rd, 8th, 11th; Glenwood, Iowa, 11th; Yates Center, Kan., 14th, 16th; Gardiner, Me., 11th; Clear Creek, Neb., 11th, 12th; Auburn, N. H., 9th, 20th; Freehold, N. J., 16th; Vineland, N. J., 8th, 12th; Wytheville, Va., 7th, 15th.

*Mirage*.—Albuquerque, N. M., 8th.

## MISCELLANEOUS PHENOMENA

*Meteors*.—Punta Rassa, 21st, 10 p. m., quite brilliant; visible about three seconds; course SE. to NW.; disappeared at elevation of about 25° with a long train of incandescent vapor. Springfield, Ill., 1st, 7:48 p. m., large and very brilliant, light sufficient to attract the notice of a person within doors, reading by a coal-oil lamp; was first seen due north at about 25° above the horizon, when it moved downward to a point 47° east and disappeared; motion very slow; no trail or cloud; duration 15 seconds. Cleburne, Tex., 21st, 6:30 p. m., very brilliant. Wytheville, Va., 6th, 6:30 p. m., very brilliant, course S. to N., motion slow until it reached the zenith, when it burst, sending its fragments in every direction, color white; 24th, 8:50 p. m., quite brilliant, rather larger than Mars; started few degrees east of station and moved eastward toward Orion, sinking a little as it passed; no train at disappearance; a few moments later another meteor of splendid bluish-green color, larger than Venus, moved from Cassiopeia towards Saturn, but sunk more rapidly than its predecessor; exploded like a rocket, throwing its fragments in every direction. Woodstock, Vt., 6:45 p. m., quite brilliant; appeared in SW. about 40° above horizon; moved in a northerly direction, leaving a brilliant white train of light visible for about six seconds.

*Earthquakes*.—*Alaska*: The following graphic description of a remarkable series of shocks occurring in Sitka Alaska in *October and November, 1880*, and which lasted for several days, is taken from the report of a special correspondent of an Oregon paper: "October 26th, 6 to 8 a. m., clear with sun shining 9 a. m., cloudy, high wind 10 a. m., tornado 11:20 a. m., cyclone, thunder, lightning, rain and hail; 1:20 p. m., severe shock of earthquake—oscillations from true east to west.

*Incidents*.—Sudden calm: rumbling; earth wave passed; second, severe upheaval with cracking and splitting noise in and beneath the ground; third, slight shock with apparent return wave. The houses of the town were regularly upheaved in the order in which they stood, showing a true wave. Time from first to third about 18 seconds. Short lull, followed by rain, hail and snow. 2:14 p. m., slight shock with little vibration. 8:46 p. m., two shocks coming from the same direction as the first. 27th, 5:35 a. m., mean time, two short and sharp shocks, direction from magnetic east to west; length of shocks and interval unnoted on account of rapidity of movement; oscillation from north to south and very perceptible, followed by snow, hail, rain and high wind. 9:15 p. m., sharp shock from southwest to northeast. 11:04'. 20'' p. m., slight shock, with continued low rumbling for the space of 1 minute and 8 seconds, from east to west. 11:45, same. From 9 to 11, scud flying from southeast to northwest. Stars shining through the break of clouds.

*Remarks*.—On Thursday, the 28th, there was no perceptible upheaval, nevertheless the phenomena was peculiar during the afternoon of that day or after meridian. I was under the impression that there was a quivering in the air, yet but few persons noticed the state of the atmosphere. Becoming satisfied that something unusual was in the elements, I watched for an effect; could only discover that nervous persons were seemingly very bouyant and restless, while others, particularly females, complained of loss of appetite, accompanied with a feeling of seasickness, and I thought I noticed a feeling akin to hysteria. Under the impression that I must be mistaken, about 6 p. m. I entered a well lighted saloon and there watched for an indication to relieve my doubts or confirm my opinion. Only one person of the whole number, there being about nine in the room, seemed to be affected. That individual, said to be one of the powerful men in the community, addressed himself to me personally several times, asking what I supposed ailed him; declined to answer the question and went to my present home. Retired for the night at 9 o'clock and 30 minutes; the

quivering sensation continued and seemed to increase; arose at ten, lighted up my room and commenced a series of experiments to determine my status, could make nothing of it; again retired; sleepless, and continued in that state until the upheaval noted on Friday morning. Confirmatory evidence of the peculiar state of the atmosphere on Thursday night and Friday morning I have received from four officers of the U. S. ship *Jamestown*, who were in the mountains hunting, some ten or more miles from here. They occupied a cabin about eight hundred feet above the level of the sea. They informed me that the quivering was so great during the whole night that not one of them could sleep. At six o'clock Friday morning they packed up and returned to the ship. 29th, 1:05 a. m., shock of considerable duration followed by heavy rain and hail. 6:38 a. m., sharp shock with long rumbling sound like distant thunder; oscillation from southeast to northwest; rain. 11:58.30' p. m., three shocks; first two in rapid succession, the third evidently the return or settling back of the crust of the earth; direction northeast to southwest; oscillation in opposite direction, which I am unable to account for, followed within three minutes by a sudden fall of rain and hail. *Remarks*—Retired at my usual hour, had lain but a few minutes when I became satisfied that we were becoming enveloped by an electric wave or current; dressed myself, lighted a lantern, and walked out of town some half a mile; tried in various ways to satisfy myself that I was correct; proved the fact beyond a doubt by extending my person on the rocks at various points of the compass; viz.: with head to the east and feet to the west the sensation and pressure was regular from head to feet; reverse position, exactly the reverse. At any angle from east to west, I could feel the electric pressure as positive as if a hand was placed on that portion of my body that came in direct contact with the current; yet the most peculiar phenomenon connected therewith was the fact that while lying down I seemed to be drifting north and south and while standing there seemed to be a desire on my part to swing about to the poles. Nov. 13, 5:28 a. m.—Shock from NE. to SE.; rapid, quick movement. Nov. 14, 5:50 a. m.—Two shocks from NE. to SW. The first upheaval sudden and quite sharp, duration about six seconds. Friday night to Saturday noon of above date, very heavy rain storm. Saturday afternoon and night, temperature 50°; high wind, almost a hurricane. On board the ship *Jamestown* the earthquake of the 26th was so violent that it was compared to striking a rock. On Tihiagreff Island, (north of this island, southeast end, it was very violent. At Hoona village, north end, it threw the Indians around like chips in an eddy. On the southeast end of Admiralty Island it shook things up lively. On the mainland, due east from the last-named island, a friend who was on a quartz prospect, informs me that the "quake," as he called it, threw him on to his head, and I believe him. The Indians here and hereabouts were very much excited. Redoubt Lake, on this island, rose six feet instantly, and fell as quick—measurements by the lodgement of drift. At the warm springs, twenty miles southeast, the invalids who were there tell me that the springs spouted like geysers. Two Russians who were prospecting at Whale Bay, thirty-six miles southeast, told me that the shocks were very severe, and that a tidal wave of huge dimensions ran into the bay, which I think very likely, as it opens broad to the sea." *California*: San Francisco, 24th, three shocks at 8:54, 9:15 and 11:15 p. m., respectively; vibrations NW. to SE.; no damage. Campo, 7th, 6:15 a. m., slight. Red Bluff, 1st, 6:55 p. m., vibrations N. to S.; windows rattled and pendant articles swung to and fro; 6th, 6:25 p. m., vibrations NW. to SE.; upward lifting motion followed by a tremor. Oakland, 24th, three shocks at 8:50, 9:20 and 11:17 p. m. respectively; first and second shocks attended by a low, rumbling sound, with vibrations from SW. to NE., all pendant objects swayed backward and forward; third shock attended with heavy concussions, shaking windows and jarring loose articles; vibrations from SW. to NE. *Maine*: Bath, 21st, 9:40 p. m., severe shock; many people startled from sleep; sound appeared somewhat like thunder, faint at first, but gradually increasing in volume, accompanied by a rattling, not like anything else, but somewhat such a noise as if chains were being dragged over bare ground. The noise increased in intensity, houses were felt to vibrate, light ornaments on shelves were seen to move and the climax was reached in a loud, explosive sound, the whole not occupying more than four or five seconds. Some people described the sound as like the rolling of a table or bed on castors, gathering strength as it moved and coming into collision with the wall, with a sudden and loud concussion. Harding's Station, 21st, 9:35 p. m., severe shock; people were startled from sleep by the accompanying noise and vibrations. The shock was also experienced at Woolwick, Phippsburg, Topsham, Richmond and Bowdoinham in Sagadahack Co., to the northward of Bath, and at places in Brunswick township to the westward. *Washington Territory*: Bainbridge Island, five shocks, all slight, with motion tremulous, viz: 5th, 10:56 p. m.; 6th, 4:20 p. m.; 7th, 10:15 p. m.; 16th, 11:00 p. m.; 30th, 9:45 p. m.

*Sunsets*.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 181 stations show 5,565 observations to have been made, of which 45 were reported doubtful; of the remainder, 4,615 or 83.6 per cent. were followed by the expected weather.

*Sun Spots*.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.:

DATE— Jan., 1881.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		REMARKS.
	Groups	Spots	Groups	Spots	Groups	Spots	Groups	Spots	
1, 11 a. m.	0	0	0	0	0	0	4	10	
2, 10 a. m.	1	1	0	0	1	1	5	11†	Faculae.
3, 12 m.	1	2	1	1	1	2	5	12†	Faculae.
12, 8 a. m.	0	0	0	0	0	0	1	3	Faculae.
17, 4 p. m.	3	13†	0	0	0	0	3	13†	
18, 9 a. m.	1	5	0	0	0	0	4	20†	Faculae.
22, 4 p. m.	0	0	0	0	0	0	1	3	Faculae.
23, 10 a. m.	1	5	0	0	0	0	2	8	
1 4 p. m.	1	12	0	0	1	4	3	20†	Faculae.
24, 8 a. m.	0	0	0	0	0	0	3	20†	
26, 9 a. m.	1	10	0	0	0	0	4	35†	Faculae.
4 p. m.	0	5	0	0	0	0	4	40†	Faculae.
27, 9 a. m.	2	10	0	0	0	0	6	60†	Faculae.
28, 10 a. m.	1	5	0	0	0	0	7	65†	
4 p. m.	0	0	0	0	0	0	7	65†	Broad areas of faculae.
31, 8 a. m.	1	20	3	20	1	5	5	65†	

† Approximated.

Mr. William Dawson, at Spiceland, Ind., reports: 1st, 5 groups, 11 spots, one large spot close to east edge; air bad. 7th, 1 group, 3 spots, two large spots nearly north of center; air bad. 8th, one group, 4 spots; air very bad. 10th, one group, 6 spots; air bad. 11th, 2 groups, 9 spots, one group 3' from west edge; the other group with faculae at east edge; air pretty good. 17th, one group, 2 spots; both large, half way from centre to NW. margin. 24th, 3 groups, 23 spots; two large spots south of centre. 28th, 5 groups, 66 spots; one large spot near west edge; five spots, all very prominent; air good.

Mr. H. D. Govey, at North Lewisburg, Ohio, says: "Observed sun spots on the 1st, 2nd, 7th, 8th, 10th, 26th and 27th.

Mr. David Trowbridge, Waterburg, N. Y., reports: "No sun spots observed; too cloudy."

## NOTES AND EXTRACTS.

[Read before the National Academy of Sciences, New York, Nov. 18, 1881.]

CONTRIBUTIONS TO METEOROLOGY, BEING RESULTS DERIVED FROM AN EXAMINATION OF THE OBSERVATIONS OF THE UNITED STATES SIGNAL SERVICE, AND FROM OTHER SOURCES; BY ELIAS Loomis, PROFESSOR OF NAT. PHIL. IN YALE COLLEGE.

*American Storms Advancing in a Southeasterly Direction.*—During the colder months of the year, storms while crossing the United States frequently advance, during a portion of their course, in a direction from northwest to southeast. This direction is not confined to any particular section of the country, but occurs most frequently in the region between the Rocky Mountains and the Mississippi River. This course is seldom maintained as far south as the parallel of 30°, and after reaching its most southerly point, the storm frequently changes its course towards the northeast. The following table shows those cases in which storms have advanced towards the southeast as far as the parallel of 28°. The arrangement is similar to that of the preceding table. The first six columns describe each storm as long as its course continued southeasterly; the last column gives some indication of the subsequent course of each storm.

No.	Date.	Latitude. beg. end.	Longitude. beg. end.	Course.	Vel. miles	Subsequent course.
1	1871. Feb. 17.2-18.2	33-27	86-79	S.E.	21.8	Unknown.
2	April 15.3-16.3	41-26	101-80	S.E.	21.1	Unknown.
3	1875. Jan. 15.1-16.2	44-27	106-91	S.E.	27.1	Unknown.
4	1876. Feb. 3-4.1	33-28	98-80	S.E.	28.4	Unknown.
5	March 6.2-12.1	47-27	127-89	S.E.	15.7	Unknown.
6	May 6.3-7.3	39-27	110-63	S.E.	25.0	Unknown.
7	1877. Jan. 4.2-5.3	46-8	100-90	S.S.E.	49.4	N.E.
8	March 21.2-24.1	45-28	100-95	S.S.E.	22.5	N.E.
9	Dec. 19-20	44-28	107-88	S.E.	10.0	N.
10	Dec. 22-27.2	47-27	102-85	S.E.	29.7	N.E.
11	1878. Feb. 1.1-2.3	33-26	96-84	S.E.	18.3	N.E.
12	Aug. 20.2-24.2	38-22	83-81	S.S.E.	15.1	Became extinct
13	Nov. 16.2-17.2	28-24	107-83	S.S.E.	24.0	N.E.
14	1879. Jan. 6.3-7.3	38-27	110-98	S.E.	39.2	N.E.
15	Jan. 8.3-11.1	49-27	110-98	S.E.	30.4	N.E.
16	May 4.1-6.1	34-24	101-96	S.S.E.	16.1	Became extinct.

wards the north or northeast. In two of the remaining cases the intensity of the storm declined in advancing southward, and they apparently became extinct soon after the dates given in the table. The same was probably true in the six remaining cases, but the observations are not sufficient to establish this with certainty.

Storm No. 12 was quite peculiar, having pursued a path almost directly opposite to that of ordinary storms. During the afternoon of Aug. 20th, 1878, there was an area of low pressure (29.75) over West Virginia, being part of a greater depression whose centre was over Newfoundland, and there was a slight tendency to the formation of an independent system of circulating winds. Owing to a slight increase of pressure on the north side, this low area was crowded south-

We see from this table that the average velocity of these storms while pursuing their course towards the southeast, was twenty-four miles per hour, which differs but little from the average velocity of storms in other parts of the United States. The lowest latitude attained by any of these storms was 22½ degrees; and in only three cases did the low-centre reach the parallel of 25 degrees. In eight cases the storm centre, after completing its course towards the southeast, changed its course and preceded to-



ward, and in the afternoon of Aug. 21st assumed the character of an independent low area (29.78) with a feeble system of circulating winds. At 7:35 a. m. Aug. 22d this low centre had been crowded south to lat 30°, the greatest observed depression being now 29.88. After this the pressure increased, and the low centre could not be distinctly traced. This example appears to illustrate the general character of areas of low pressure, and shows that their progressive movement is not due to a simple drifting of the atmosphere, but rather to a diminution of pressure on one side of the low area and an increase of pressure on the other side. In the present case there was scarcely an appreciable diminution of pressure on the south side, and only a slight increase of pressure on the north side.

*American Storms Advancing Northerly and Easterly.*—The storms which cross the United States north of the parallel of 38 degrees, generally pursue a course a little to the north of east; while those which come from the region south of lat. 38 degrees generally pursue a course nearly north-east, especially in the neighborhood of the Atlantic coast. During the summer months few storm-centres travel south of the parallel of 38 degrees, and during this period the average course of storms is almost exactly towards the east.

The following table shows those cases in which storms have traveled northward and eastward, and came from a point as far south as lat. 26°. The arrangement of the table is similar to that of the preceding. Columns 3 and 4 show the position of the storm-centre at the beginning and end of the northeasterly motion, as far as indicated by the observations; column 8th shows the lowest pressure reported, and column 8th gives a brief indication of the previous course of the storm.

We see from this table that storms of this class occur most frequently in the autumn, and least frequently in summer. One of these storms began near lat. 20°; and seventeen of them began south of lat. 24°.

No.	Date.	Latitude. beg. end.	Long. beg. end.	Course.	Vel. miles	Lowest Barom.	Previous course.
1	1872. Nov. 6.1-7.3	26-47	95-55	E.N.E.	30.4	29.71	Unknown.
2	Nov. 7.3-9.3	25-30	95-78	E.N.E.	21.1	29.74	Unknown.
3	Dec. 9.3-13.3	26-47	101-57	N.E.	28.6	29.66	Unknown.
4	Dec. 25.2-27.2	25-44	95-58	N.E.	29.5	29.17	Unknown.
5	1874. Feb. 19.1-22.1	21-43	98-64	N.E.	35.1	29.17	Unknown.
6	May 4.1-11.1	24-43	95-81	N.E.	15.8	29.57	Unknown.
7	Sept. 18.1-20.1	24-34	92-94	N.E.	24.3	30.57	Unknown.
8	Sept. 22.3-24.1	25-50	86-72	N.E.	28.5	29.78	Unknown.
9	Oct. 5.1-8.2	25-43	87-62	N.E.	32.9	29.62	Towards N.W.
10	Dec. 24.2-27.1	24-43	88-62	N.E.	30.4	29.37	Unknown.
11	1874. Jan. 5.2-9.1	25-49	87-68	N.N.E.	18.0	29.42	Unknown.
12	Feb. 7.2-11.1	25-46	82-58	N.N.E.	25.0	28.95	Towards N.W.
13	April 17.3-24.1	24-46	94-0	N. & N.E.	29.7	29.30	Unknown.
14	Sept. 2.3-10.2	22-50	99-89	North.	21.5	29.47	Unknown.
15	Sept. 27.1-30.2	25-50	87-66	N.N.E.	26.0	28.94	Unknown.
16	Dec. 18.2-21.1	25-52	96-62	N.E.	34.6	29.33	Unknown.
17	1875. Nov. 6.1-7.3	25-31	98-78	E.N.E.	32.9	30.82	Unknown.
18	1876. Oct. 19.1-21.1	21-32	82-72	N.N.E.	19.5	29.51	Not traceable.
19	1877. Sept. 16.1-21.3	25-31	96-76	E.N.E.	10.7	29.40	Unknown.
20	1878. Jan. 6.1-12.2	24-46	100-56	N.E.	26.4	28.85	Not traceable.
21	Feb. 26.2-28.1	24-30	92-71	E.N.E.	31.1	29.71	Came from N.W.
22	March 17.1-17.2	25-25	85-78	E.N.E.	7	29.79	Not traceable.
23	March 19.3-22.3	25-27	95-78	East.	15.0	29.71	Came from W.
24	July 2.1-2.3	25-27	85-78	E.N.E.	22.6	29.77	Not traceable.
25	Sept. 24-33	15-32	76-61	N. & N.E.	10.1	29.70	Not traceable.
26	Oct. 21.1-24.2	26-38	81-57	N. & E.	27.5	28.83	Not traceable.
27	Nov. 13.3-20.1	23-44	97-57	E. & N.E.	24.5	29.53	Not traceable.
28	Nov. 17.2-21.1	24-47	93-57	N.E.	40.3	29.47	Came from N.W.
29	1879. Nov. 19.1-20.3	25-49	74-99	N.N.E.	48.8	29.00	Not traceable.
30	1880. Jan. 24-28.1	21-36	86-75	North.	14.3	29.68	Not traceable.
31	March 7.3-9.2	26-32	99-74	E.N.E.	38.0	29.86	Not traceable.
32	May 3.1-6.2	26-47	93-59	N.E.	23.5	29.79	Unknown.
33	Aug. 19-20	26-27	78-74	N.N.E.	12.4	28.96	Towards N.W.

Three of these storms had been traveling towards the northwest, previous to the dates given in the table, and two of them came from the Northwest; but in the other cases, the barometric depression was too small to allow us to trace their course previous to the dates here given. For most of the cases in the last half of the table this is clearly shown by the International Observations, and we may therefore infer it to be true in the other cases. As long as these storms continued south of lat. 30°, the barometric depression was generally small, but it increased as the storm advanced northward. In fifteen cases the barometer fell below 29.5 inches, and in four cases it fell below 29.0 inches. The average velocity of prog-

ress of these storm-centres while advancing northward and eastward was 26.9 miles per hour. From a comparison of these three tables we perceive that the American storms which originate between the equator and lat. 20° N., generally travel towards a point between north and west, but occasionally they advance almost exactly northward.

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*J. B. Hazen*

Chief Signal Officer.

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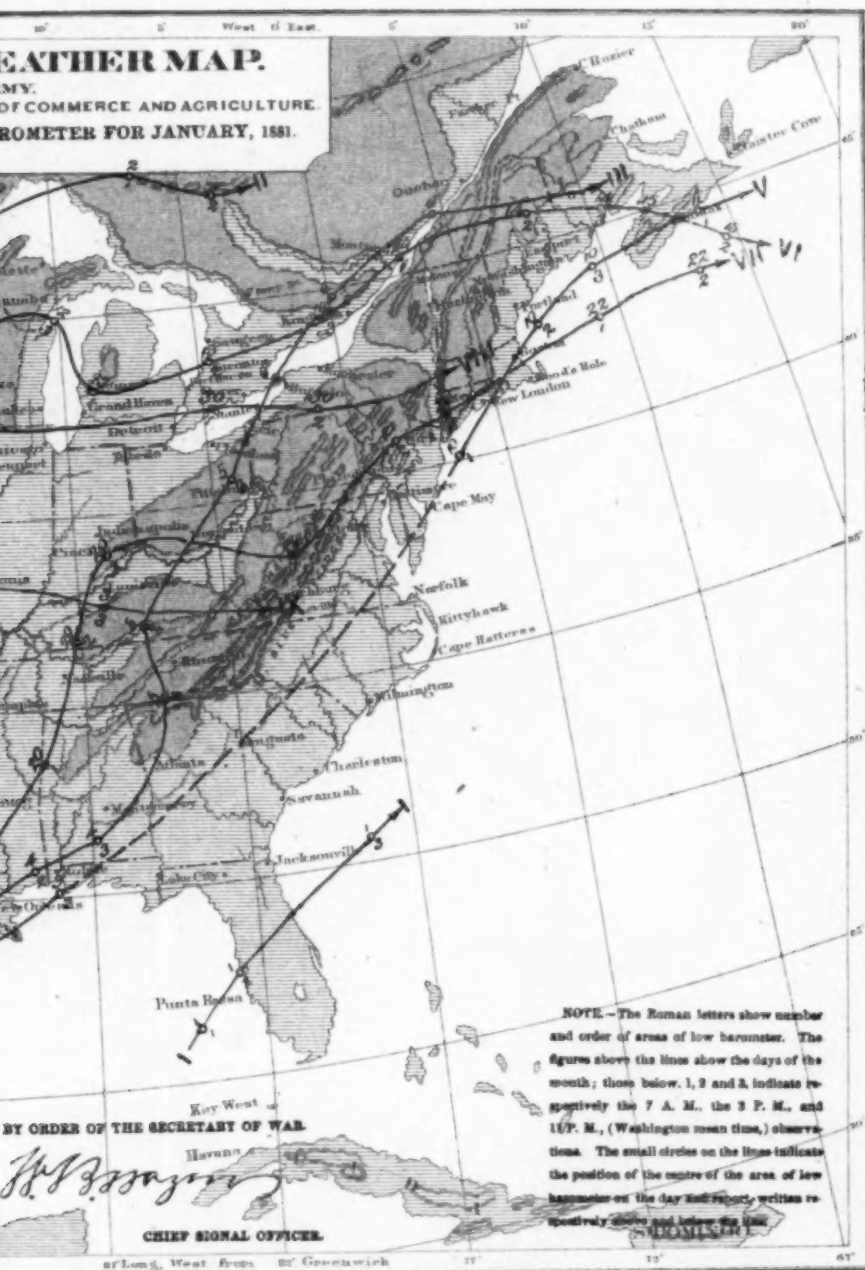
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No. 1.



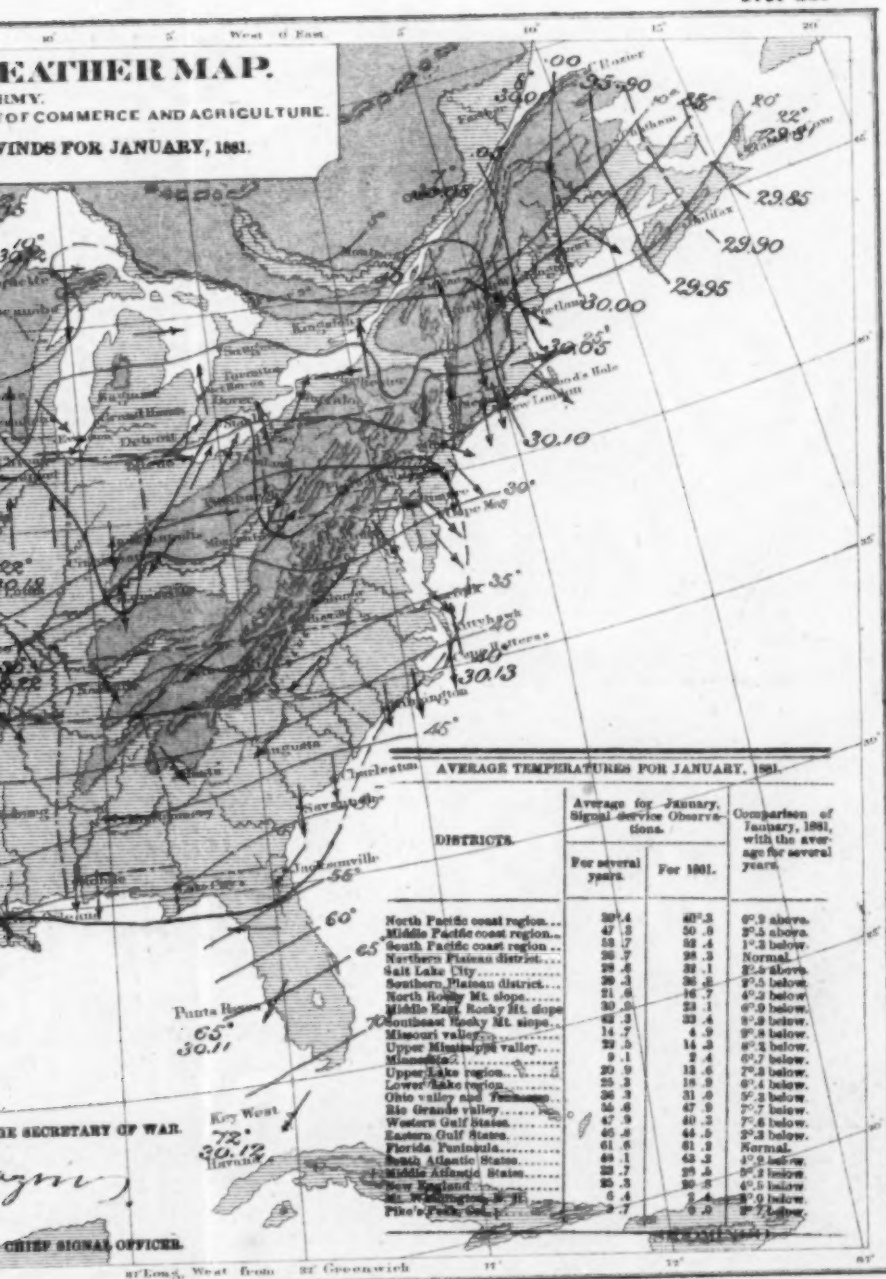
**WAR DEPARTMENT WEATHER**  
SIGNAL SERVICE, U. S. ARMY.  
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COM  
ISOBARS, ISOTHERMS AND PREVAILING WINDS FOR



## WEATHER MAP.

NAVY.  
DEPARTMENT OF COMMERCE AND AGRICULTURE.

WINDS FOR JANUARY, 1881.



SECRETARY OF WAR.

CHIEF SIGNAL OFFICER.

ST. Louis, West from ST. Greenwich



AVERAGE PRECIPITATION FOR JANUARY			
DISTRICTS	Average for January		Comparison of with the aver- age for many years.
	For many years.	For 1901.	
	Inches.	Inches.	Inches.
New England States.....	3.16	6.94	2.78 excess.
Middle Atlantic States.....	3.19	5.90	2.71 excess.
South Atlantic States.....	5.95	6.19	0.24 excess.
Florida Peninsula.....	3.74	5.94	2.20 excess.
Eastern Gulf States.....	4.45	5.90	1.45 excess.
Western Gulf States.....	3.61	4.79	1.17 excess.
Tennessee.....	4.94	4.11	0.83 deficiency.
Ohio Valley.....	3.65	3.21	0.44 deficiency.
Lower Lake Region.....	3.48	0.51	2.97 deficiency.
Upper Lake Region.....	1.56	1.49	0.07 excess.
Upper Mississippi Valley.....	1.69	1.87	Normal.
Minnesota.....	0.60	1.03	1.68 excess.
Lower Mississippi Valley.....	3.18	0.51	2.67 deficiency.
Upper Mississippi Valley.....	0.50	1.67	0.57 excess.
Upper Missouri Valley.....	7.08	9.00	2.61 on excess.
North Pacific Coast Region.....	3.07	2.95	0.12 excess.
South Pacific Coast Region.....	2.48	1.18	1.30 deficiency.

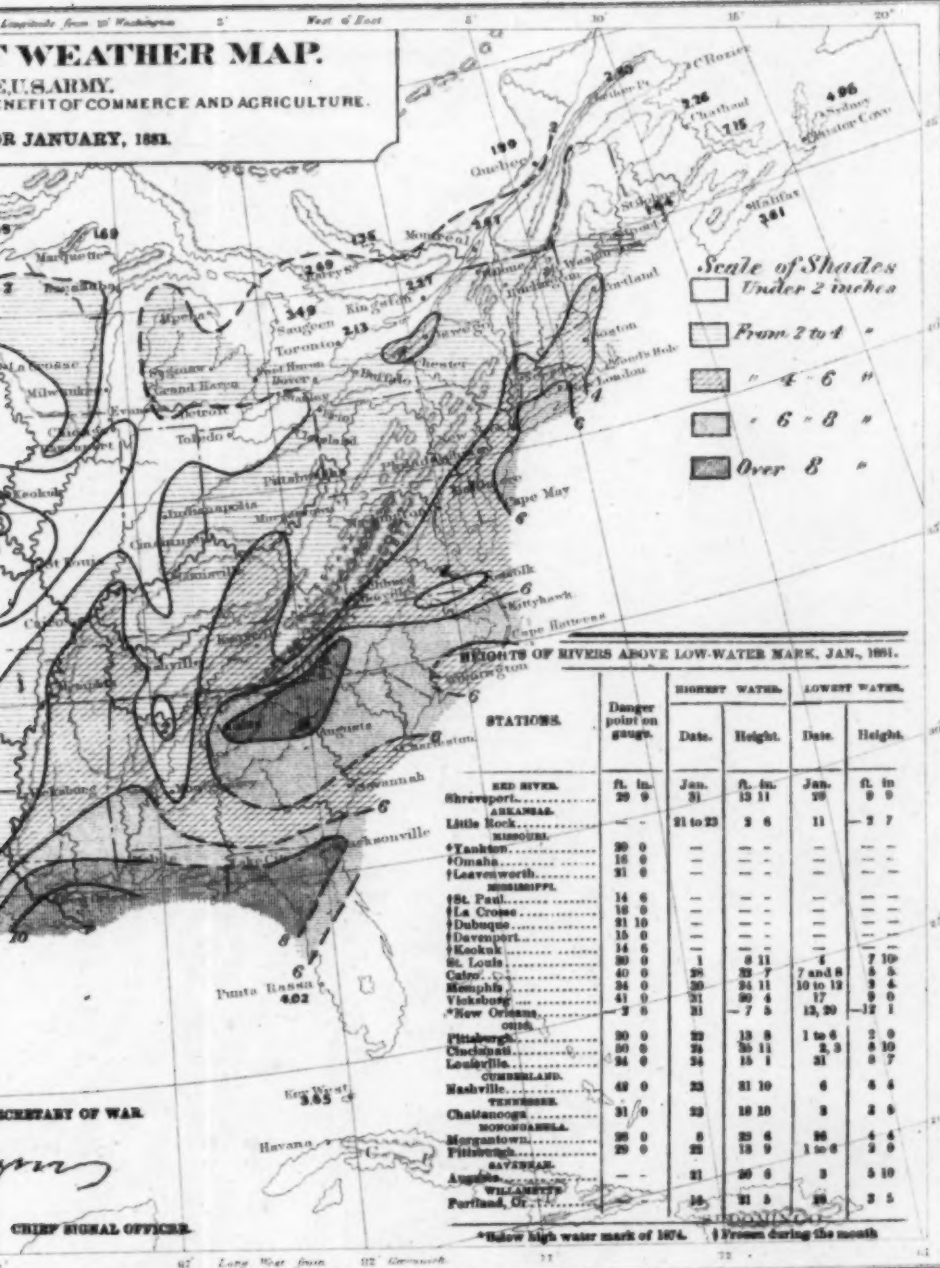


CHART No. IV.

INDEX TO STORM-TRACES.

- No. I. From Dec. 1st to 31st, 1880.  
II. From Dec. 11th to 17th, 1880.  
III. From Dec. 18th to 25th, 1880.  
IV. From Dec. 26th to 31st, 1880.  
V. From Dec. 1st to 11th, 1881.







**Office of the Chief Signal Officer,**

**UNITED STATES ARMY.**

**Charted from Actual Observations taken Simultaneously, Series commencing January, 1877.**

**No. V.**





#### PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind.  
Force is shown as follows:

SYMBOLS.	FORCE.	VELOCITY.	
		Miles per hour.	Metres per second.
	1, 2	0 to 9	0 to 4.0
	3, 4	9.1 to 22.6	4.1 to 10.1
	5, 6	22.6 to 40.5	10.1 to 18.1
	7, 8	40.5 to 67.5	18.1 to 30.2
	9, 10	67.5 up.	30.2 & over.

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*W. H. S. P.*

CHIEF SIGNAL OFFICER, U. S. A.

#### ISOBARS AND ISOTHERMS.

Iso-bars in blue; detached barometer means in English inches.

Isotherms in red; detached temperature means in degrees Fahrenheit.

Broken lines, are doubtful.

#### INTERNATIONAL MONTHLY CHART.

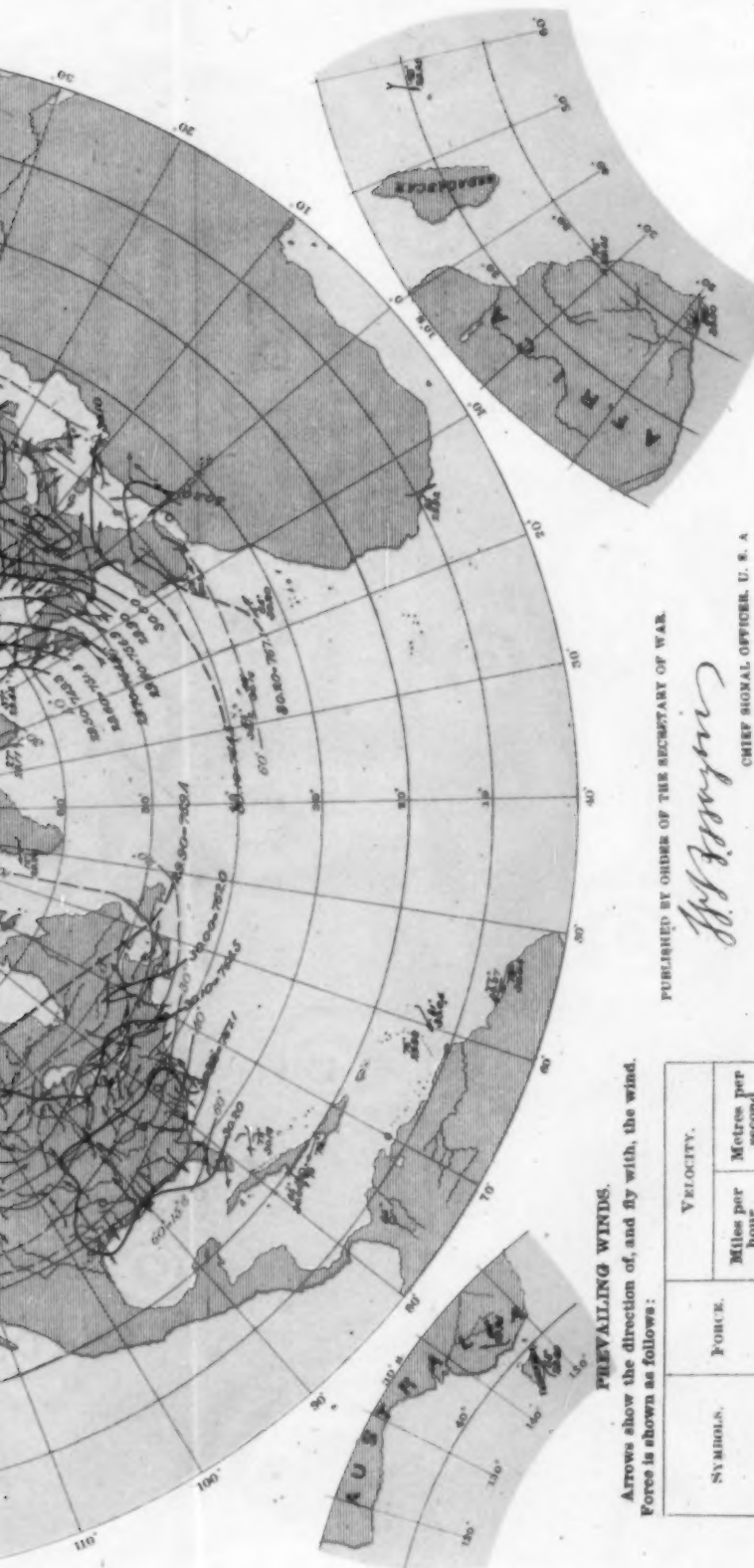
Showing mean pressures, mean temperatures, mean force and prevailing direction of winds at 7:30 A. M., Washington mean time, for the month of February, 1877, based on the daily charts of the International Bulletin



**Office of the Chief Signal Officer,**  
**UNITED STATES ARMY.**  
**Charted from Actual Observations taken Simultaneously, Series commencing January, 1877.**

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CHIEF SIGNAL OFFICER, U. S. A.

**ISOBARS AND ISOTHERMS.**  
Isobars in blue; detached barometer means in English inches.  
Isotherms in red; detached temperature means in degrees Fahrenheit.  
Broken lines, are doubtful.

### INTERNATIONAL MONTHLY CHART.

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of January, 1877, based on the daily charts of the International Bulletin